OSTEOLOGY OF LIVING AND FOSSIL NEW WORLD QUAIL

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INTRODUCTION

The New World quail form a group of rather small-sized galliform birds that range throughout the tropical, subtropical, and temperate regions of the Americas. Most workers consider the New World quail to represent a subfamily of the Phasianidae, the Odontophorinae. The North American species are quite well known individually, and an especially voluminous literature on such subjects as ecological tolerance, food and nutrition, artificial propogation, and miscellaneous life history studies has grown out of the value of the group as game birds. The Central and South American forms are generally less well known. Crispens (1960) provides a source for literature on the economic and management aspects of North American species. Ridgway and Friedmann (1944) include an excellent bibliography on the taxonomic aspects of both North and Central American forms. Hellmayr and Conover (1942) give references to the literature of South American forms.

The classification of galliform taxa at the family level and above is based mainly on internal anatomy, whereas that of taxa below the family level is based mainly on external features. Thus, the New World quail are defined on the following characters (Ridgway and Friedmann, 1944):

(1) mandibular tomium serrated or toothed; (2) tail less than half to more than one-third as long as wing; (3) tarsus less than one-fourth to more than one-third as long as wing; (4) bill relatively short and stout; (5) rectrices 10-14; (6) tarsus without spurs; (7) acrotarsium with a single row of broad, transverse scutellae; and (8) planta tarsi with two or more definite rows of moderately long scutellae, but also covered with small scales. The serrated or toothed mandibular tomium is unique in the order, whereas the other characters occur singly or in various combinations in other families and subfamilies.

Genera of New World quail are defined on such characters as ratios involving the relative lengths of bill and limbs; development of head plumes; number of rectrices; relative length of primaries; markings of chest, sides, and flanks; shape of tail; and scutellation of tarsus. Species and subspecies are defined almost entirely on the basis of coloration, markings, and size.

Since there has been no comprehensive study of a comparative nature concerning the internal anatomy of the genera of the New World quail, both the interrelationships of forms and their relationships to other Galli are poorly understood. A few works of an anatomical or physiological nature contain suggestions as to the affinities of the New World quail. Shufeldt (1909) compared skeletons of five genera of North American quail with those of various other gallinaceous birds, and remarked that bones of the chicken (Gallus gallus) and quail were basically similar. Hudson, Lanzillotti, and Edwards (1959) compared the pelvic muscles of five genera of New World quail and favored the inclusion of the group with the pheasants and the peacocks in the subfamily Phasianinae. Sibley (1960) studied the electrophoretic properties of the egg-white proteins of four genera of North American quail and tentatively suggested that the New World quail appear to form as distinct a group as certain other galliforms which are given family or subfamily rank in current classifications.

This work includes three phases. The families and subfamilies of the suborder Galli are redefined on the basis of osteological characters. The skeletons of the living genera, species, and subspecies of New World quail, insofar as available, are described; and criteria are established for the various taxa. The osteological variations of the fossil material are evaluated.

MATERIALS AND METHODS

The skeletal collection of Dr. Pierce Brodkorb at the University of Florida was supplemented by material borrowed from the United States National Museum (through Dr. Herbert Friedmann), University of Michigan Museum of Zoology (through Dr. H. B. Tordoff), University of California Museum of Zoology (through Dr. Frank A. Pitelka), and Southern Illinois University Wildlife Research Collection (through Dr. W. D. Klimstra). Fossil specimens studied in the present work are in the Brodkorb collection at the University of Florida, the University of Oregon Museum of Natural History (through Dr. J. Arnold Shotwell), and the Texas Memorial Museum (through Dr. John A. Wilson).

The number of specimens studied is listed below. Incomplete skeletons are given in parentheses.

Family Cracidae: Mitu mitu 1, Crax globulosa 1, Crax rubra 1, Penelopina niger (1), Ortalis vetula (4).

Family Tetraonidae: Lyrurus tetrix (2), Lagopus lagopus 1, Canachites canadensis (2), Bonasa umbellus 2, Pedioecetes phasianellus 1.

Family Numididae: Numida meleagris 2, Acryllium vulturinum 7.

Family Meleagrididae: *Meleagris gallopavo* 8.

Family Phasianidae, subfamily Perdicinae: *Alectoris graeca* 2, *Alectoris rufa* (1), *Francolinus bicalcaratus* (1), *Perdix perdix* 1 (+ 1), *Coturnix coturnix* 3 (+ 1).

Family Phasianidae, subfamily Phasianinae: *Lophophorus impejanus* 1, *Gennaeus nycthemerus* 1, *Gallus gallus* 3, *Catreus wallichii* 1, *Phasianus colchicus* 3, *Chrysolophus pictus* 1, *Argusianus angus* 1, *Pavo cristatus* 1, *Pavo muticus* 2.

Family Phasianidae, subfamily Odontophorinae: *Dendrortyx leucophrys* 1, *Philortyx fasciatus* 1, *Oreortyx picta* 4, *Callipepla squamata* 4, *Colinus virginianus floridanus* 9 (+ 1), *Colinus virginianus virginianus* x *floridanus* 23, *Colinus virginianus insignis* 2 (+ 3), *Colinus virginianus coyolcos* (1), *Colinus virginianus virginianus* 65, *Colinus nigrogularis* (2), *Colinus leucopogon* 4, *Lophortyx californica* 2 (+ 1), *Lophortyx gambelii* 2, *Lophortyx douglasii* 2, *Odontophorus gujanensis* 1 (+ 1), *Odontophorus stellatus* 1, *Odontophorus guttatus* 1, *Dactylortyx thoracicus* 3, *Cyrtonyx montezumae* 3, *Rhynchortyx cinctus* 1.

The fossil specimens include 795 elements, detailed in the body of the work.

All measurements are linear and to the nearest tenth millimeter. Although 60 intramembral and intermembral ratios were taken, only those that proved useful are presented herein.

Anatomical nomenclature follows that of Howard (1929).

OSTEOLOGY OF LIVING GALLI

The suborder Galli forms a very large group of almost world-wide distribution, yet its families are quite similar in basic morphology, and interfamilial hybrids occur. These factors have made a natural classification difficult, and at present several systems are in use.

The classification generally followed in the United States is that of Wetmore (1930, 1951, and 1960). Wetmore divides the order Galliformes into two suborders, the Opisthocomi, which includes the hoatzins, and the suborder Galli for the remaining groups. The suborder Galli is divided into two superfamilies, the Cracoidea, and the Phasianoidea. The superfamily Cracoidea includes the families Megapodiidae (mound-builders) and Cracidae (curassows). The superfamily Phasianoidea includes the families Tetraonidae (grouse), Phasianidae (pheasants, quails, peacocks), Numididae (guineafowl), and Meleagrididae (turkeys).

Friedmann (1946) follows the classification of Wetmore but further divides the Phasianidae into three subfamilies, the Odontophorinae (New World quails), Perdicinae (Old World quails), and Phasianinae (pheasants, junglefowls, and peacocks).

Other authoritative interpretations are given by Stresemann (1959), who considers the Galli and Opisthocomi of Wetmore as separate orders; and Sibley (1960), who considers the order Galliformes to be composed of three families, the Megapodiidae, the Phasianidae (with subfamilies Phasianinae, Meleagridinae, Numidinae, Tetraoninae, and Cracinae), and the Opisthocomidae.

A somewhat intermediate view is taken by Mayr and Amadon (1951), who consider the order Galli (Galliformes of Wetmore) to be composed of five families, Megapodiidae, Cracidae, Phasianidae (with subfamilies Phasianinae, Numidinae, and Tetraoninae), Meleagrididae, and Opisthocomidae.

The classification of Wetmore will be used in the following section on descriptive osteology but will be modified later. Some of the more definitive osteological characters of the suborder Galli are included below.

Axial skeleton.--The palate is schizognathous and has both a vomer and a well developed basipterygoid process. The nasal fossae are holorhinal, and the mandible has a long angular process. Sixteen cervical vertebrae are present, and their haemapophyses are unringed. The sternum has a perforated common spine, long anterior lateral processes, two pairs of metasternal notches, and its xiphoid area is long and narrow.

Appendicular skeleton.--The furculum is Y-shaped, and has a large hypocleidium. The coracoid is long, straight, and narrow, and its procoracoid process is small. The humerus is short and stout, and its shaft has a sigmoid curve. The caput humerus is large and round, the coraco-humeral groove is indistinct, and the deltoid crest is short, with its summit inflected. The ectepicondylar process is rudimentary. The ulna is short, curved, flattened medially, and has the distal end enlarged. The carpometacarpus has the metacarpal III produced beyond the metacarpal II, and the metacarpal I is directed posteriorly. The femur is long and curved, with its anterior intermuscular line continuous with the trochanter, and its external condyle produced lower than the internal condyle. The tibiotarsus is long, with its outer cnemial crest pointed, and with a supratendinal bridge at the distal end. The tarsometatarsus is flattened antero-posteriorly, and its middle condyle is much the longest.

The present study of the osteology of Recent Galli was undertaken to define more exactly the Odontophorinae as a taxonomic unit, and to shed light on the relative importance of the characters of its fossil and Recent members. Nevertheless, osteological characters that appear to be useful in evaluating the status of the other taxa of the Galli have been included. Those skeletal elements most frequently found as fossils have been utilized for the study.

Family CRACIDAE Carus 1868

Rostrum.--(1) Long, but deep, highly compressed, and strongly decurved, with a dorsal bony knob in Mitu and Crax.

Sternum.---(2) Manubrial spine with a very large dorsal foramen. (3) Anterior lateral processes short, broad, straight, and at right angles to long axis of sternum. (4) Anterior area of sternal plate highly pneumatic. (5) Inner notch of sternum short, less than half length of sternum, thus posterior lateral and posterior medial processes arising independently from sternum.

Coracoid.---(6) Medial surface of head rounded. (7) Brachial tuberosity without overhanging ventral portion. (8) Dorsal intermuscular line not sharply raised distally. (9) Ventral intermuscular line terminating near lateral end of sternal facet. (10) Distal dorsal face with large pneumatic fossa. (11) Sterno-coracoidal process without terminal knob.

Scapula.---(12) Ventral base of glenoid facet with a large pneumatic fossa. (13) Area mediad to glenoid facet in dorsal aspect usually without depression (with slight depression in Crax). (14) Bridge between acromion process and glenoid facet non-pneumatic. (15) Acromion process deflected. (16) Dorsal base of shaft non-pneumatic. (17) Blade usually very short and wide (moderately short and wide in Ortalis), without dorsal groove, but with its dorsal surface very shallowly concave, its apex without terminal expansion.

Humerus.---(18) Pneumatic fossa very small, with internal anconal border of bicipital crest wide, and with inner shelf extending from medial bar to internal bicipital surface. (19) Fossa II (Ashley, 1941) absent. (20) Bicipital crest usually with its lateral margin rounded (with its lateral margin truncated in *Mitu*).

Ulna.--(21) External cotyla well developed, with its margin usually rounded throughout (with dorsal border flattened in *Crax globulosa*).

Carpometacarpus.--(22) Pisiform process obsolete, and at level of its ligamental attachment. (23) Intermetacarpal tubercle obsolete, represented only by a minute point. (24) Carpal trochlea with its external rim continuing distad beyond ligamental notch.

Pelvis.--(25) Relatively narrow and deep. (26) Pectineal process obsolete, with a pneumatic foramen on its anterior border. (27) Anterior portion of renal depression with a large pneumatic fossa. (28) Renal bar usually broad (slender in *Ortalis*), without pneumatic foramen.

Femur.--(29) Head swollen, its dorsal border above level of iliac facet. (30) Dorsal crest of trochanter low. (31) Area mediad to anterior border of trochanter without pneumatic fossa.

Tibiotarsus.--(32) Inner cnemial crest arising from shaft well below level of outer cnemial crest. (33) Internal distal ligamental attachment within limits of border of internal condyle. (34) External distal ligamental attachment not produced as a tubercle.

Tarsometatarsus.---(35) Hypotarsus with one closed calcaneal canal. (36) Inner calcaneal ridge without distal extension. (37) Posterior shaft without spur core. (38) Trochlea for digit II at level of trochlea for digit IV. (39) Posterior metatarsal groove deeply excavated, with its lateral margin swinging gently onto posterior face of shaft. (40) Medial lip of internal cotyla weakly elevated, below level of intercotylar prominence. (41) Intercotylar prominence weakly produced.

Intermembral proportions.---(42) Ulna/humerus 106-107 per cent (Table 1). (43) Carpometacarpus/ulna 49-50 per cent. (44) Femur/tibiotarsus 67-69 per cent. (45) Tarsometatarsus/femur 94-102 per cent. (46) Tarsometatarsus/tibiotarsus 64-69 per cent. (47) Ulna/femur 104 per cent. (48) Ulna/tibiotarsus 71 per cent. (49) Carpometacarpus/femur 52-53 per cent. (50) Carpometacarpus/tarsometatarsus 51-57 per cent. (51) Ilium/sternum 92 per cent.

Family TETRAONIDAE Vigors 1825

Rostrum.---(1) Long and shallow, slightly decurved, and without a dorsal bony knob.

Sternum.---(2) Manubrial spine usually without dorsal foramen (with an obsolete dorsal foramen in Pedioecetes). (3) Anterior lateral processes elongate and slender, moderately decurved, and nearly parallel to long axis of sternum. (4) Anterior area of sternal plate slightly pneumatic. (5) Inner notch of sternum long, more than half length of sternum, thus posterior lateral and posterior medial processes arising from a common base.

Coracoid.---(6) Medial surface of head rounded. (7) Brachial tuberosity with overhanging ventral portion. (8) Dorsal intermuscular line sharply raised distally. (9) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (10) Distal dorsal face with large pneumatic fossa. (11) Sterno-coracoidal process ending in a terminal knob.

Scapula.---(12) Ventral base of glenoid facet without pneumatic fossa. (13) Area mediad to glenoid facet in dorsal aspect without depression. (14) Bridge between acromion process and glenoid facet with a large pneumatic fossa. (15) Acromion process deflected. (16) Dorsal base of shaft non-pneumatic. (17) Blade moderately short and wide, without dorsal groove, but with its dorsal surface shallowly concave, its apex expanding terminally.

Humerus.---(18) Pneumatic fossa moderately large, with internal anconal border of bicipital crest wide, usually without inner shelf (with inner shelf extending from medial bar to internal bicipital surface in Bonasa). (19) Fossa II obsolete. (20) Bicipital crest with its lateral margin rounded.

Ulna.---(21) External cotyla well developed, with its margin rounded throughout.

Carpometacarpus.--(22) Pisiform process obsolete, and at level of its ligamental attachment. (23) Intermetacarpal tubercle well developed, extending to level of metacarpal III. (24) Carpal trochlea with its external rim ending at ligamental notch.

Pelvis.--(25) Very wide and shallow. (26) Pectineal process obsolete, with a pneumatic foramen on its medial face. (27) Anterior portion of renal depression without pneumatic fossa (with a few pneumatic perforations in Bonasa). (28) Renal bar broad, usually with a large pneumatic foramen (without pneumatic foramen in Pedioecetes).

Femur.--(29) Head swollen, its dorsal border above level of iliac facet. (30) Dorsal crest of trochanter moderately high. (31) Area mediad to anterior border of trochanter with a pneumatic fossa.

Tibiotarsus.--(32) Inner cnemial crest arising from shaft well below level of outer cnemial crest. (33) Internal distal ligamental attachment within limits of border of internal condyle. (34) External distal ligamental attachment not produced as a tubercle.

Tarsometatarsus.--(35) Hypotarsus with one closed calcaneal canal. (36) Inner calcaneal ridge usually extending three-fourths the way down shaft as a sharp ridge (without distal extension in Lagopus). (37) Posterior shaft without spur core. (38) Trochlea for digit II elevated above level of trochlea for digit IV. (39) Posterior metatarsal groove moderately excavated, with its lateral margin swinging abruptly onto posterior face of shaft. (40) Medial lip of internal cotyla elevated to level of intercotylar prominence. (41) Intercotylar prominence well produced.

Intermembral proportions.--(42) Ulna/humerus 92-94 per cent (Table 1). (43) Carpometacarpus/ulna 58-62 per cent. (44) Femur/tibiotarsus 75-80 per cent. (45) Tarsometatarsus/femur 74 per cent. (46) Tarsometatarsus/tibiotarsus 50-56 per cent. (47) Ulna/femur 83-94 per cent. (48) Ulna/tibiotarsus 62-75 per cent. (49) Carpometacarpus/femur 51-55 per cent. (50) Carpometacarpus/tarsometatarsus 69-83 per cent. (51) Ilium/sternum 69-80 per cent.

Family PHASIANIDAE Vigors 1825

Subfamily Odontophorinae Gray 1846

Rostrum.--(1) Short and deep, strongly decurved, and without a dorsal bony knob.

Sternum.--(2) Manubrial spine without dorsal foramen. (3) Anterior lateral process elongate and slender, straight or slightly decurved, and nearly parallel to long axis of sternum. (4) Anterior area of sternal plate usually only slightly pneumatic (non-pneumatic in Cyrtonyx, Dactylortyx, Odontophorus, moderately pneumatic in Oreortyx). (5) Inner notch of sternum long, more than half length of sternum, thus posterior lateral and posterior medial processes arising from a common base.

Coracoid.--(6) Medial surface of head rounded. (7) Brachial tuberosity with overhanging ventral portion. (8) Dorsal intermuscular line sharply raised distally. (9) Ventral intermuscular line usually terminating at tip of sterno-coracoidal process (terminating in middle of distal border of sterno-coracoidal process in Dendrortyx). (10) Distal dorsal face without pneumatic fossa. (11) Sterno-coracoidal process usually ending in a terminal knob (with an obsolete terminal knob in Philortyx, without terminal knob in Dendrortyx).

Scapula.--(12) Ventral base of glenoid facet without pneumatic fossa. (13) Area mediad to glenoid facet in dorsal aspect with a depression. (14) Bridge between acromion process and glenoid facet non-pneumatic. (15) Acromion process deflected. (16) Dorsal base of shaft non-pneumatic. (17) Blade very elongate, with its dorsal surface deeply grooved throughout, and with its apex expanding terminally.

Humerus.--(18) Pneumatic fossa much enlarged, thus internal anconal border of bicipital crest narrow, usually without inner shelf (with inner shelf in Odontophorus gujanensis extending from medial bar to internal bicipital surface. (19) Fossa II usually well developed (obsolete in Dendrortyx and Odontophorus). (20) Bicipital crest with its lateral margin rounded.

Ulna.--(21) External cotyla well developed, usually with its margin rounded throughout (margin flattened in *Dendrortyx*, and *Odontophorus guttatus*).

Carpometacarpus.---(22) Pisiform process produced medially, thus extending well beyond level of its ligamental attachment. (23) Intermetacarpal tubercle well developed and usually extending to level of metacarpal III (not reaching level of metacarpal III in some individuals of *Cyrtonyx*). (24) Carpal trochlea with its external rim ending at ligamental notch.

Pelvis.---(25) Pelvis relatively narrow and deep. (26) Pectineal process obsolete, usually without pneumatic foramen (with a pneumatic foramen on its medial face in *Dendrortyx*). (27) Anterior portion of renal depression without pneumatic fossa. (28) Renal bar slender in *Dendrortyx*, *Philortyx*, *Oreortyx*, *Callipepla*, *Colinus*, and *Lophortyx*, broad in *Rhynchortyx*, *Cyrtonyx*, *Dactylortyx*, and *Odontophorus*, without pneumatic foramen.

Femur.---(29) Head swollen, its dorsal border above level of iliac facet. (30) Dorsal crest of trochanter moderately high in *Philortyx*, *Oreortyx*, *Callipepla*, *Dactylortyx*, and most *Lophortyx*, low in *Rhynchortyx*, *Cyrtonyx*, *Odontophorus*, and most *Colinus*. (31) Area mediad to anterior border of trochanter without a pneumatic fossa.

Tibiotarsus.---(32) Inner cnemial crest arising from shaft well below level of outer cnemial crest. (33) Internal distal ligamental attachment within limits of border of internal condyle. (34) External distal ligamental attachment not produced as a tubercle.

Tarsometatarsus.---(35) Hypotarsus usually with two closed calcaneal canals (one closed calcaneal canal in *Dendrortyx* and *Rhynchortyx*, usually one in *Oreortyx*). (36) Inner calcaneal ridge without distal extension. (37) Posterior shaft without spur core. (38) Trochlea for digit II elevated above level of trochlea for digit IV. (39) Posterior metatarsal groove moderately excavated, with its lateral margin swinging abruptly onto posterior face of shaft. (40) Medial lip of internal cotyla elevated to level of intercotylar prominence. (41) Intercotylar prominence well produced.

Intermembral proportions.---(42) Ulna/humerus 86-102 per cent (Table 1). (43) Carpometacarpus/ulna 55-63 per cent. (44) Femur/tibiotarsus 78 per cent. (45) Tarsometatarsus/femur 70-88 per cent. (46) Tarsometatarsus/tibiotarsus 53-63 per cent. (47) Ulna/femur 68-93 per cent. (48) Ulna/tibiotarsus 45-47 per cent. (49) Carpometacarpus/femur 37-52 per cent. (50) Carpometacarpus/tarsometatarsus 42-74 per cent. (51) Ilium/sternum 65-89 per cent.

Subfamily Perdicinae Bonaparte 1838

Rostrum.---(1) Long and shallow, usually slightly decurved (very slightly decurved in *Coturnix*), and without a dorsal bony knob.

Sternum.---(2) Manubrial spine without dorsal foramen. (3) Anterior lateral process elongate and slender, straight or slightly decurved, and nearly parallel to long axis of sternum. (4) Anterior area of sternal plate usually only slightly pneumatic (non-pneumatic in Coturnix). (5) Inner notches of sternum long, more than half length of sternum, thus posterior lateral and posterior medial processes arising from a common base.

Coracoid.---(6) Medial surface of head rounded. (7) Brachial tuberosity with overhanging ventral portion. (8) Dorsal intermuscular line sharply raised distally. (9) Ventral intermuscular line usually terminating at tip of sterno-coracoidal process (terminating at lateral end of sternal facet in Coturnix). (10) Distal dorsal face without pneumatic fossa. (11) Sterno-coracoidal process ending in a terminal knob.

Scapula.---(12) Ventral base of glenoid facet without pneumatic fossa. (13) Area mediad to glenoid facet in dorsal aspect with a depression. (14) Bridge between acromion process and glenoid facet non-pneumatic. (15) Acromion process deflected. (16) Dorsal base of shaft non-pneumatic. (17) Blade very elongate and narrow, with its dorsal surface shallowly grooved in Coturnix; moderately elongate and narrow with its proximal and distal dorsal surface grooved in Alectoris; moderately elongate with its dorsal surface flat in Perdix; apices expanding terminally in all above forms.

Humerus.--(18) Pneumatic fossa usually much enlarged, thus internal anconal border of bicipital crest usually narrow (fossa moderately large with internal anconal border of bicipital crest wide in Perdix); usually without inner shelf (with inner shelf in Perdix extending from medial bar to internal bicipital surface). (19) Fossa II well developed in Coturnix, weakly developed in Alectoris, obsolete in Perdix. (20) Bicipital crest with its lateral margin rounded.

Ulna.--(21) External cotyla well developed, with its margin rounded throughout.

Carpometacarpus.--(22) Pisiform process usually obsolete and thus at level of its ligamental attachment (produced medially, thus extending well beyond level of its ligamental attachment in Coturnix). (23) Intermetacarpal tubercle usually well developed and extending to level of metacarpal III (very weakly developed and not reaching metacarpal III in Coturnix). (24) Carpal trochlea with its external rim ending at ligamental notch.

Pelvis.--(25) Pelvis relatively narrow and deep. (26) Pectineal process well developed, long and narrow, without pneumatic foramen. (27) Anterior portion of renal depression without pneumatic fossa. (28) Renal bar usually broad (slender in Coturnix), and with a pneumatic foramen.

Femur.--(29) Head swollen, its dorsal border above level of iliac facet. (30) Dorsal crest of trochanter moderately high. (31) Area mediad to anterior border of trochanter without a pneumatic fossa.

Tibiotarsus.---(32) Inner cnemial crest usually arising from shaft at level of outer cnemial crest (arising from shaft well below level of outer cnemial crest in Coturnix). (33) Internal distal ligamental attachment within limits of border of internal condyle. (34) External distal ligamental attachment not produced as a tubercle.

Tarsometatarsus.---(35) Hypotarsus with one closed calcaneal canal. (36) Inner calcaneal ridge usually without distal extension (extending about half-way down shaft as a sharp ridge in Alectoris). (37) Posterior shaft usually without spur core (with rudimentary spur core in male Alectoris). (38) Trochlea for digit II elevated above level of trochlea for digit IV. (39) Posterior metatarsal groove moderately excavated with its lateral margin swinging abruptly onto posterior face of shaft. (40) Medial lip of internal cotyla elevated to level of intercotylar prominence. (41) Intercotylar prominence well produced.

Intermembral proportions.---(42) Ulna/humerus 84-96 per cent (Table 1). (43) Carpometacarpus/ulna 59-68 per cent. (44) Femur/tibiotarsus 74-80 per cent. (45) Tarsometatarsus/femur 75-81 per cent. (46) Tarsometatarsus/tibiotarsus 57-62 per cent. (47) Ulna/femur 76-83 per cent. (48) Ulna/tibiotarsus 59-65 per cent. (49) Carpometacarpus/femur 47-53 per cent. (50) Carpometacarpus/tarsometatarsus 62-69 per cent. (51) Ilium/sternum 83-95 per cent.

Subfamily Phasianinae Gray 1840

Rostrum.--(1) Very long and shallow, slightly decurved, and without a dorsal bony knob.

Sternum.--(2) Manubrial spine usually without dorsal foramen (with a moderately large dorsal foramen in Catreus, Phasianus, and Argusianus). (3) Anterior lateral process usually slightly elongate and slender (shorter and broader in Pavo), usually slightly decurved, (strongly decurved in Gennaeus and Catreus), nearly parallel to long axis of sternum. (4) Anterior area of sternal plate usually only slightly pneumatic (moderately pneumatic in Gennaeus and Chrysolophus). (5) Inner notches of sternum long, more than half as long as sternum, thus posterior lateral and posterior medial processes arising from a common base.

Coracoid.--(6) Medial surface of head rounded.
(7) Brachial tuberosity with overhanging ventral portion.
(8) Dorsal intermuscular line usually not sharply raised distally (raised slightly in Gallus and Chrysolophus).
(9) Ventral intermuscular line usually terminating near lateral end of sternal facet (terminating at tip of sterno-coracoidal process in Gallus, Catreus, and Argusianus).
(10) Distal dorsal face with large pneumatic fossa.
(11) Sterno-coracoidal process ending in obsolete terminal knob.

Scapula.---(12) Ventral base of glenoid facet usually without pneumatic fossa (with small pneumatic fossa in *Argusianus*). (13) Area mediad to glenoid facet usually without depression (with a slight depression in *Lophophorus*, *Phasianus*, and *Chrysolophus*). (14) Bridge between acromion process and glenoid facet usually non-pneumatic (slightly pneumatic in *Argusianus*, with a large pneumatic fossa in *Pavo*). (15) Acromion process deflected. (16) Dorsal base of shaft non-pneumatic. (17) Blade usually moderately short and wide, with its dorsal surface without dorsal groove, but with its dorsal surface shallowly concave, and with its apex expanding terminally (very short and wide without dorsal groove, but with its dorsal surface very shallowly concave, and with its apex without terminal expansion in *Pavo*).

Humerus.---(18) Pneumatic fossa moderately large, with internal anconal border of bicipital crest wide, and with inner shelf extending from medial bar to internal bicipital surface. (19) Fossa II obsolete. (20) Bicipital crest with its lateral margin rounded.

Ulna.---(21) External cotyla well developed, with its margin usually rounded throughout (truncated in *Argusianus*).

Carpometacarpus.---(22) Pisiform process produced medially, thus extending well beyond level of its ligamental attachment. (23) Intermetacarpal tubercle usually well developed (weakly developed in *Pavo*), usually extending to level of metacarpal III (not reaching level of metacarpal

III in Gennaeus and Catreus). (24) Carpal trochlea with its external rim ending at ligamental notch.

Pelvis.---(25) Pelvis relatively narrow and deep. (26) Pectineal process usually well developed, long and narrow (obsolete in Pavo cristatus), with pneumatic foramen on its medial face. (27) Anterior portion of renal depression without pneumatic fossa, but with a few small foramina in Lophophorus, Gallus, Catreus, Argusianus, and Pavo. (28) Renal bar broad, usually without pneumatic foramen (with a small pneumatic foramen in Argusianus).

Femur.---(29) Head swollen, its dorsal border above level of iliac facet. (30) Dorsal crest of trochanter moderately high. (31) Area mediad to anterior border of trochanter usually with pneumatic fossa (pneumatic fossa laterad to posterior aspect of head in Argusianus, without pneumatic fossa in Lophophorus and Gallus).

Tibiotarsus.---(32) Inner cnemial crest arising from shaft well below level of outer cnemial crest. (33) Internal distal ligamental attachment within limits of border of internal condyle. (34) External distal ligamental attachment not produced as a tubercle.

Tarsometatarsus.---(35) Hypotarsus with one closed calcaneal canal. (36) Inner calcaneal ridge usually extending about three-fourths the way down shaft as a sharp ridge (without distal extension in Gallus). (37) Posterior shaft with spur core in male. (38) Trochlea for digit II elevated above level of trochlea for digit IV. (39) Posterior metatarsal groove moderately excavated, with its lateral margin swinging abruptly onto posterior face of shaft. (40) Medial lip of internal cotyla elevated to level of intercotylar prominence. (41) Intercotylar prominence well produced.

Intermembral proportions.--(42) Ulna/humerus 88-103 per cent (Table 1). (43) Carpometacarpus/ulna 51-60 per cent. (44) Femur/tibiotarsus 57-77 per cent. (45) Tarsometatarsus/femur 76-121 per cent. (46) Tarsometatarsus/tibiotarsus 57-72 per cent. (47) Ulna/femur 69-114 per cent. (48) Ulna/tibiotarsus 49-72 per cent. (49) Carpometacarpus/femur 38-59 per cent. (50) Carpometacarpus/tarsometatarsus 39-66 per cent. (51) Ilium/sternum 73-95 per cent.

Family NUMIDIDAE Sharpe 1891

Rostrum.--(1) Long and shallow, slightly decurved, and without a dorsal bony knob.

Sternum.--(2) Manubrial spine with a moderately large dorsal foramen. (3) Anterior lateral processes short, broad, straight and at about 45 degrees angle to long axis of sternum. (4) Anterior area of sternal plate moderately pneumatic. (5) Inner notch of sternum long, more than half length of sternum, thus posterior lateral and posterior medial processes arising from a common base.

Coracoid.--(6) Medial surface of head rounded. (7) Brachial tuberosity with overhanging ventral portion.

(8) Dorsal intermuscular line only slightly raised distally. (9) Ventral intermuscular line terminating near lateral end of sternal facet in Acryllium, near tip of sterno-coracoidal process in Numida. (10) Distal dorsal face without pneumatic fossa. (11) Sterno-coracoidal process ending in obsolete terminal knob.

Scapula.--(12) Ventral base of glenoid facet without pneumatic fossa. (13) Area mediad to glenoid facet without depression in Numida, with slight depression in Acryllium. (14) Bridge between acromion process and glenoid facet non-pneumatic. (15) Acromion process deflected. (16) Dorsal base of shaft non-pneumatic. (17) Blade very short and wide, without dorsal groove, but with its dorsal surface shallowly concave; its apex expanding terminally in Numida, without terminal expansion in Acryllium.

Humerus.--(18) Pneumatic fossa small, with internal anconal border of bicipital crest wide, and with inner shelf extending from medial bar to internal bicipital surface. (19) Fossa II obsolete. (20) Bicipital crest with its lateral margin truncated.

Ulna.--(21) External cotyla well developed in Numida (only moderately well developed in Acryllium), rounded throughout.

Carpometacarpus.--(22) Pisiform process obsolete and at level of its ligamental attachment in Acryllium, produced medially, thus extending well beyond level of its ligamental attachment in Numida. (23) Intermetacarpal tubercle absent. (24) Carpal trochlea with its external rim ending at ligamental notch.

Pelvis.--(25) Pelvis relatively narrow and deep. (26) Pectineal process obsolete, without pneumatic foramen. (27) Anterior portion of renal depression with a large pneumatic fossa in Acryllium, with a moderately large pneumatic fossa in Numida. (28) Renal bar broad, without pneumatic foramen.

Femur.--(29) Head swollen, its dorsal border above level of iliac facet. (30) Dorsal crest of trochanter moderately high. (31) Area mediad to anterior border of trochanter without pneumatic fossa.

Tibiotarsus.--(32) Inner cnemial crest arising from shaft well below level of outer cnemial crest in Acryllium, at level of outer cnemial crest in Numida. (33) Internal distal ligamental attachment within limits of border of internal condyle. (34) External distal ligamental attachment not produced as a tubercle.

Tarsometatarsus.--(35) Hypotarsus with one closed calcaneal canal. (36) Inner calcaneal ridge without spur core. (37) Posterior shaft without spur core. (38) Trochlea for digit II elevated above level of trochlea for digit IV. (39) Posterior metatarsal groove moderately excavated, with its lateral margin swinging abruptly onto posterior face of shaft. (40) Medial lip of internal cotyla elevated to level of intercotylar prominence. (41) Intercotylar prominence well produced.

Intermembral proportions.--(42) Ulna/humerus 95-111 per cent (Table 1). (43) Carpometacarpus/ulna 48-55 per cent. (44) Femur/tibiotarsus 63-76 per cent. (45) Tarsometatarsus/femur 83-114 per cent. (46) Tarsometatarsus/tibiotarsus 61-72 per cent. (47) Ulna/femur 91-111 per cent. (48) Ulna/tibiotarsus 64-71 per cent. (49) Carpometacarpus/femur 49-57 per cent. (50) Carpometacarpus/tarsometatarsus 48-60 per cent. (51) Ilium/sternum 88-94 per cent.

Family MELEAGRIDIDAE Coues 1874

Rostrum.--(1) Long and shallow, very slightly decurved, and without a dorsal bony knob.

Sternum.--(2) Manubrial spine without dorsal foramen. (3) Anterior lateral processes elongate and slender, moderately decurved, and nearly parallel to long axis of sternum. (4) Anterior area of sternal plate moderately pneumatic. (5) Inner notch of sternum long, more than half length of sternum, thus posterior lateral and posterior medial processes arising from a common base.

Coracoid.--(6) Medial surface of head much flattened. (7) Brachial tuberosity without overhanging ventral portion. (8) Dorsal intermuscular line not sharply raised distally. (9) Ventral intermuscular line terminating near lateral end of sternal facet. (10) Distal dorsal face with large pneumatic fossa. (11) Sterno-coracoidal process ending in obsolete terminal knob.

Scapula.--(12) Ventral base of glenoid facet without pneumatic fossa. (13) Area mediad to glenoid facet without depression. (14) Bridge between acromion process and glenoid facet non-pneumatic. (15) Acromion process straight. (16) Dorsal base of shaft with a pneumatic fossa. (17) Blade very short and wide, without dorsal groove, but with its dorsal surface very shallowly concave, and with its apex expanding terminally.

Humerus.--(18) Pneumatic fossa small, with internal anconal border of bicipital crest wide, and with inner shelf extending from medial bar to internal bicipital surface. (19) Fossa II obsolete. (20) External cotyla only weakly developed, with its margin truncated.

Carpometacarpus.--(22) Pisiform process produced medially, thus extending well beyond level of its ligamental attachment. (23) Intermetacarpal tubercle well developed, extending to level of metacarpal III. (24) Carpal trochlea with its external rim ending at ligamental notch.

Pelvis.--(25) Pelvis relatively narrow and deep. (26) Pectineal process obsolete, with small pneumatic foramina. (27) Anterior portion of renal depression non-pneumatic. (28) Renal bar very broad, without pneumatic foramen.

Femur.--(29) Head flattened, its dorsal border at level of iliac facet. (30) Dorsal crest of trochanter very high. (31) Area mediad to anterior border of trochanter without pneumatic fossa.

Tibiotarsus.---(32) Inner cnemial crest usually arising from shaft well above level of outer cnemial crest. (33) Internal distal ligamental attachment often extending onto dorsal border of internal condyle. (34) External distal ligamental attachment usually a produced, elongate, tubercle.

Tarsometatarsus.---(35) Hypotarsus with one closed calcaneal canal. (36) Inner calcaneal ridge extending about three-fourths the way down shaft as a sharp ridge. (37) Posterior shaft with spur core in male. (38) Trochlea for digit II elevated above level of trochlea for digit IV. (39) Posterior metatarsal groove moderately excavated, with its lateral margin swinging abruptly onto posterior face of shaft. (40) Medial lip of internal cotyla weakly elevated, below level of intercotylar prominence. (41) Intercotylar prominence weakly produced.

Intermembral proportions.---(42) Ulna/humerus 97-100 per cent (Table 1). (43) Carpometacarpus/ulna 56 per cent. (44) Femur/tibiotarsus 58-65 per cent. (45) Tarsometatarsus/femur 110 per cent. (46) Tarsometatarsus/tibiotarsus 61-72 per cent. (47) Ulna/femur 101-106 per cent. (48) Ulna/tibiotarsus 61-70 per cent. (49) Carpometacarpus/femur 58 per cent. (50) Material lacking. (51) Ilium/sternum

86-88 per cent.

Summary

Variable characters that are neither associated with an evolutionary sequence nor are of any particular taxonomic use are omitted from the following paragraphs.

Rostrum.--The rostrum is long and shallow, slightly decurved, and without ornamentation in most Galli. The Cracidae have the rostrum long, but deep and much compressed, and ornamented with a dorsal bony knob in Mitu and Crax. The Odontophorinae have the rostrum without ornamentation, but short, deep, and strongly decurved.

Sternum.--The sternum is an important element in the classification of galliform birds. The sternum of the primative hoatzins of the suborder Opisthocomi is two-notched, and the sternal plate is wider posteriorly than anteriorly, whereas in the suborder Galli it is four-notched and the sternal plate is wider anteriorly than posteriorly. The superfamilies Cracoidea and Phasianoidea of the Galli are also separable on sternal characters. In the Cracoidea the inner notches are less than half the length of the sternum and the sternal plate is only slightly narrower posteriorly than anteriorly, whereas in the Phasianoidea the inner notches are much more than half the length of the sternum, and the sternal plate is much constricted posteriorly. The families Magapodiidae and Cracidae of the Cracoidea may be separated on the basis that the sternum is more than twice as long as its inner notch in the Magapodiidae, and less than twice as long as its inner notch in the Cracidae (Ridgway and Friedmann, 1946).

A very large dorsal foramen occurs on the manubrial spine in the Cracidae. This foramen is present, but only moderately large in the Numididae, Catreus, Phasianus, and Argusianus of the Phasianinae, and is obsolete in Pedioecetes of the Tetraonidae. The structure is absent in adults of the remaining Galli.

The anterior lateral processes of the Cracidae are short, broad, and at right angles to the long axis of the sternum. In the Numididae the anterior lateral processes are short and broad, but make angles of about 45 degrees to the long axis of the sternum. In the other forms the anterior lateral processes are long, slender, and parallel to the long axis of the sternum.

The anterior area of the sternal plate is highly pneumatic in the Cracidae, whereas it is only moderately pneumatic in the Numididae and Meleagrididae. In the Phasianinae the anterior sternal plate is moderately pneumatic in Gennaeus and Chrysolophus, but only slightly pneumatic in the remaining forms. The Tetraonidae have the slightly pneumatic condition, whereas the Odontophorinae and Perdicinae have the anterior sternal plate non-pneumatic or only slightly pneumatic.

Some noteworthy errors in Ridgway and Friedmann (1946) regarding the sternum of the Galli should be mentioned at this point. (1) The characters for separation of the superfamilies Cracoidea and Phasianoidea are reversed (p. 4). (2) The characters "... outer divisions of the short, broad lateral process widely expanded terminally on both sides ...," and "... the episternal process perforated to receive the feet of the coracoids..." (p. 5) are used to separate the superfamily Cracoidea from the Phasianoidea. Neither of the above characters are diagnostic; the former is found in all members of the subfamily Galli, whereas the latter character is found in all of the galliform birds.

Coracoid.--The medial surface of the head is much flattened in the Meleagrididae, whereas it is rounded in the other Galli.

The brachial tuberosity of the Cracidae and the Meleagrididae is without the overhanging ventral portion found in the other Galli.

The dorsal intermuscular line is not raised distally in the Cracidae, Meleagrididae, and most Phasianinae. It is slightly raised distally in the Numididae, Gallus and Chrysolophus of the Phasianinae, and sharply raised distally in the Tetraonidae, Perdicinae, and Odontophorinae.

The ventral intermuscular line terminates near the lateral end of the sternal facet in the Cracidae, Meleagrididae, Acryllium of the Numididae, Lophophorus, Gennaeus, Chrysolophus, and Pavo of the Phasianinae, and Coturnix of the Perdicinae. In Dendrortyx of the Odontophorinae the ventral intermuscular line terminates in the middle of the distal border of the sterno-coracoidal process, whereas in the remaining Galli it terminates at the tip of the sterno-coracoidal process.

The distal dorsal face of the Cracidae, Meleagrididae, Phasianinae, and Tetraonidae has a large pneumatic fossa which is absent in the Odontophorinae and Perdicinae.

The sterno-coracoidal process of the Cracidae and Dendrortyx of the Odontophorinae is without the terminal knob found in the other Galli. In the Numididae, Meleagrididae, Phasianinae, and in Philortyx of the Odontophorinae this knob is obsolete, whereas it is well developed in the remaining forms.

Scapula.--The ventral base of the glenoid facet has a large pneumatic fossa in the Cracidae, and a small one in Argusianus of the Phasianinae. The other Galli lack this opening.

The area mediad to the glenoid facet is without a depression in most Cracidae, in Numida of the Numididae, the Meleagrididae, Tetraonidae, and most Phasianinae. A depression is present in this area in Crax of the Cracidae, Acryllium of the Numididae, Lophophorus, Phasianus, and Chrysolophus of the Phasianinae, the Odontophorinae, and in the Perdicinae.

The bridge between the acromion process and glenoid facet is excavated by a large pneumatic fossa in the Tetraonidae, and Pavo of the Phasianinae, whereas this structure is lacking in the other forms.

The acromion process is straight in the Meleagrididae, but deflected in the other Galli.

The dorsal base of the shaft has a pneumatic fossa in the Meleagrididae, but is without this structure in the other forms.

The scapular blade is very short and wide in most Cracidae, the Numididae, the Meleagrididae, and Pavo of the Phasianinae. It is moderately short and wide in Ortalis of the Cracidae, the Tetraonidae, and most Phasianinae. It is usually moderately elongate in the Perdicinae, and is very elongate in Perdix of the Perdicinae, and in the Odontophorinae.

The dorsal surface of the blade is shallowly concave in the Cracidae, Numididae, Meleagrididae, Tetraonidae, and Phasianinae. It is flat, shallowly concave, or shallowly grooved in the Perdicinae, and deeply grooved throughout in the Odontophorinae.

The apex of the scapular blade is without terminal expansion in the Cracidae, Acryllium of the Numididae, and Pavo of the Phasianinae, whereas it is expanded terminally in the remaining Galli.

Humerus.--The pneumatic fossa is very small, and has an inner shelf that extends from the medial bar to the internal bicipital surface in the Cracidae. The Numididae and Meleagrididae have this fossa small, but larger than in the Cracidae, and both the former families retain the inner shelf. In the Phasianinae and Tetraonidae the pneumatic fossa is moderately large. The inner shelf persists in all of the Phasianinae, but is present only in *Bonasa* of the Tetraonidae. In most Perdicinae, and in the Odontophorinae, the pneumatic fossa is much enlarged, and an inner shelf is present only in *Perdix* of the Perdicinae, and *Odontophorus gujanensis* of the Odontophorinae.

The fossa II is absent in the Cracidae, obsolete in the Numididae, Meleagrididae, Phasianinae, and Tetraonidae, *Perdix* of the Perdicinae, and *Dendrortyx* and *Odontophorus* of the Odontophorinae. It is weakly developed in *Alectoris* of the Perdicinae, and well developed in *Coturnix* of the Perdicinae, and in most Odontophorinae.

The bicipital crest has its lateral border truncated in *Mitu* of the Cracidae, and in the Numididae, whereas this structure is variously rounded in the other Galli.

Ulna.--The external cotyla is weakly developed in the Cracidae, and only moderately developed in *Numida* of the Numididae. This structure is well developed in the other Galli. The border of the external cotyla is truncated in the Meleagrididae and *Argusianus* of the Phasianinae. It is flattened dorsally in *Crax globulosa* of the Cracidae, and in

Dendrortyx and Odontophorus guttatus of the Odontophorinae, whereas it is rounded in the other Galli.

Carpometacarpus.--The pisiform process is obsolete and at the level of its ligamental attachment in the Cracidae, Acryllium of the Numididae, the Tetraonidae, and most Perdicinae. It is produced medially and thus extends well beyond the level of its ligamental attachment in Numida of the Numididae, the Meleagrididae, Phasianinae, Coturnix of the Perdicinae, and the Odontophorinae.

The intermetacarpal tubercle is absent in the Numididae, and represented only by a minute point in the Cracidae. It is weakly developed in Pavo of the Phasianinae, and Coturnix of the Perdicinae. It is well developed and usually extends to the metacarpal III in the other Galli.

The external rim of the carpal trochlea continues distad beyond the ligamental notch in the Cracidae, whereas the rim ends at the ligamental notch in the other Galli.

Pelvis.--The pelvis is very wide and shallow in the Tetraonidae, whereas it is relatively narrow and deep in the other forms.

The pectineal process is obsolete in the Cracidae, Numididae, Meleagrididae, Pavo cristatus of the Phasianinae, the Tetraonidae, and the Odontophorinae. It is well developed, long, and narrow in most Phasianinae, and in the Perdicinae. One or more pneumatic foramina occur on the pectineal process of the Cracidae, Meleagrididae, Phasianinae, Tetraonidae, and Dendrortyx of the Odontophorinae. In other Galli the pectineal process is non-pneumatic.

The anterior portion of the renal depression has a large pneumatic fossa in the Cracidae and Numididae. The other Galli lack a discrete fossa, but there are some pneumatic perforations in this area in most Phasianinae and in Bonasa of the Tetraonidae.

The renal bar is broad in most Cracidae, the Numididae, Meleagrididae, Phasianinae, Tetraonidae, most Perdicinae, and Rhynchortyx, Cyrtonyx, Dactylortyx, and Odontophorus of the Odontophorinae. It is slender in Ortalis of the Cracidae, Coturnix of the Perdicinae, and in most Odontophorinae.

The renal bar has a pneumatic foramen in Argusianus of the Phasianinae, most Tetraonidae, and the Perdicinae. It is without this structure in Pedioecetes of the Tetraonidae and in the remaining Galli.

Femur.--The femur has apparently undergone less modification than many other skeletal elements of the Galli.

The head of the femur is flattened, and has its dorsal border at the level of the iliac facet in the Meleagrididae, whereas the head is swollen and has its dorsal border above the level of the iliac facet in the other Galli.

The dorsal crest of the trochanter is very high in the Meleagrididae, whereas it is low in the Cracidae, and several genera of the Odontophorinae. It is moderately high in the other Galli.

The area mediad to the anterior border of the trochanter is without a pneumatic fossa in the Cracidae, Numididae, Meleagrididae, Lophophorus and Gallus of the Phasianinae, the Perdicinae, and the Odontophorinae. A pneumatic fossa occurs in this area in most Phasianinae and in the Tetraonidae.

Tibiotarsus.--The tibiotarsus is one of the less useful elements in the determination of relationships within the Galli. This element shows little change in its basic structure, yet has much individual variation in minor characters.

The inner cnemial crest arises from the shaft well above the level of the outer cnemial crest in most individuals of the Meleagrididae, at the level of the outer cnemial crest in Numida of the Numididae, and Alectoris and Perdix of the Perdicinae, and well below the level of the outer cnemial crest in the remaining forms.

The internal distal ligamental attachment often extends onto the dorsal border of the internal condyle in the Meleagrididae, but it is within the limits of the border of the internal condyle in the other forms.

The external distal ligamental attachment is usually a produced, elongate tubercle in the Meleagrididae, whereas this structure is obsolete in the other Galli.

Tarsometatarsus.--The tarsometatarsus is the leg element most useful in analysis of evolutionary trends in the Galli.

The hypotarsus usually has two roofed calcaneal canals in the Odontophorinae. Exceptions are Dendrortyx, Rhynchortyx, and most specimens of Oreortyx, which have a single roofed calcaneal canal. The rest of the Galli have only one roofed canal.

The inner calcaneal ridge of the Cracidae, Numididae, Gallus of the Phasianidae, Lagopus of the Tetraonidae, Alectoris and Perdix of the Perdicinae, and of the Odontophorinae is without the distal extension that extends one-half to two-thirds the way down the shaft in the other forms.

The posterior shaft has a spur core in the male of the Meleagrididae and Phasianidae. The male of Alectoris of the Perdicinae has a rudimentary spur core, but this structure is lacking in the remaining Galli examined. Spur cores are said to occur in the francolins.

The trochlea for digit II is at the level of the trochlea for digit IV in the Cracidae, but it is elevated above the level of the trochlea for digit IV in the other Galli.

The posterior metatarsal groove is deeply excavated, with its lateral margin swinging gently onto the posterior face of the shaft in the Cracidae, whereas it is moderately excavated, with its lateral margin swinging abruptly onto the posterior face of the shaft in the other forms.

The medial lip of the internal cotyla is weakly elevated and below the level of the intercotylar prominence in the Cracidae and Meleagrididae, whereas it is elevated to the level of the intercotylar prominence in the other Galli.

The intercotylar prominence is weakly produced in the Cracidae, but is well produced in the other forms.

Intermembral ratios.--Numerical intermembral ratios of the Galli at the specific level are given in Table 1.

The carpometacarpus is half or less the length of the ulna in the Cracidae, whereas it is more than half the length of the ulna in the remaining Galli (with the exception of one specimen of Acryllium).

The femur is less than 70 per cent as long as the tibiotarsus in the Cracidae, Acryllium of the Numididae, the Meleagrididae, and Argusianus and Pavo of the Phasianinae, but is more than 70 per cent the length of the femur in the other forms.

The tarsometatarsus is over 90 per cent as long as the femur in the Cracidae, Acryllium of the Numididae, the Meleagrididae, and Gennaeus, Gallus, Argusianus and Pavo of the Phasianinae, but is less than 90 per cent the length of the femur in the other Galli.

The ulna is longer than the femur in the Cracidae, Acryllium of the Numididae, the Meleagrididae, and Argusianus and Pavo of the Phasianinae. It is shorter than the femur in the other Galli.

Relationships of Taxa

Of the Galli studied in the present work, the Cracidae have been considered to be most primative by the majority of authors. The recent work of Hudson, Lanzillottii, and Edwards (1959) on the pelvic limb musculature in galliform birds tends to confirm this view. The arrangement of the families in the classification presented below is based largely upon several trends in the Phasianoidea towards modification of skeletal structures found in the Cracidae. These trends are summarized in the section on evolutionary trends. On the basis of osteology it is suggested that the classification of the suborder Galli be modified in the following manner:

Wetmore's classification	Proposed classification
Superfamily Cracoidea	Superfamily Cracoidea
Family Megapodiidae	Family Megapodiidae
Family Cracidae	Family Cracidae
Superfamily Phasianoidea	Superfamily Phasianoidea
Family Tetraonidae	Family Numididae
Family Phasianidae	Family Meleagrididae
Family Numididae	Family Phasianidae
Family Meleagrididae	Family Tetraonidae
	Family Odontophoridae

The above changes include placing the Numididae and Meleagrididae nearer the Cracidae, to which they show skeletal relationships as well as to each other. The Tetraonidae are placed in a higher position than the Phasianidae, which show more relationships with the Cracidae, Numididae, and Meleagrididae in several osteological characters. The New

World quail are recognized as a separate family the Odontophoridae, rather than a subfamily of the Phasianidae, and are thought to be the most highly evolved group of the Galli. The systematic status of the Old World quail of the subfamily Perdicinae is doubtful, but they are here included with the Phasianidae.

Osteological characters indicate that the groups recognized in the present paper as families represent natural divisions (with the possible exception of the Phasianidae), but it should be pointed out that several authors, especially Sibley (1960), believe that there is taxonomic inflation in galliform classification, and that the families of Phasianoidea recognized by Wetmore might better be treated as subfamilies

Evolutionary Trends

(1) Reduction and loss of the dorsal foramen in the manubrial spine of the sternum: Cracidae (foramen very large), Numididae (foramen moderately large), Phasianidae (foramen moderately large or absent), Tetraonidae (foramen obsolete or absent), Meleagrididae and Odontophoridae (foramen absent).

(2) Modification of the anterior lateral processes of the sternum: Cracidae (processes short, broad, at right angles to long axis of sternum), Numididae (processes short, broad, at 45 degree angles to long axis of sternum),

Meleagrididae, Phasianidae, Tetraonidae, Odontophoridae (processes long, narrow, parallel to long axis of sternum).

(3) Decreasing pneumaticity of anterior sternal plate: Cracidae (plate highly pneumatic), Numididae and Meleagrididae (plate moderately pneumatic), Phasianidae (plate moderately, slightly, or non-pneumatic), Tetraonidae (plate slightly pneumatic), Odontophoridae (plate slightly or non-pneumatic).

(4) Development of an overhanging ventral portion of the brachial tuberosity of the coracoid: Cracidae and Meleagrididae (overhanging ventral portion absent), Numididae, Phasianidae, Tetraonidae, Odontophoridae (overhanging ventral portion present).

(5) Development of a sharply raised distal portion of the dorsal intermuscular line of the coracoid: Cracidae and Meleagrididae (line without sharply raised distal portion), Phasianidae (line usually without sharply raised distal portion, but may be slightly or sharply raised distally), Numididae (line slightly raised distally), Tetraonidae and Odontophoridae (line sharply raised distally).

(6) Shifting position of termination of ventral intermuscular line of coracoid: Cracidae and Meleagrididae (line terminates near lateral end of sternal facet), Phasianidae (line usually terminates near lateral end of sternal facet, occasionally at tip of sterno-coracoidal process), Numididae (line terminates near lateral end of sternal facet or at tip of sterno-coracoidal process), Odontophoridae (line usually

terminates at tip of sterno-coracoidal process, occasionally at middle of distal border of sterno-coracoidal process), Tetraonidae (line terminates at tip of sterno-coracoidal process).

(7) Development of a terminal knob on the sterno-coracoidal process of the coracoid: Cracidae (process without terminal knob), Numididae and Meleagrididae (process with a very small terminal knob), Phasianidae (process usually with a very small terminal knob, occasionally with a well developed terminal knob), Odontophoridae (process usually with a well developed terminal knob, occasionally with terminal knob very small or absent), Tetraonidae (process with a well developed terminal knob).

(8) Change in the shape of the scapular blade: Numididae and Meleagrididae (blade very short and wide, shallowly concave dorsally), Cracidae (blade usually very short and wide, occasionally moderately elongate, shallowly concave dorsally), Phasianidae (blade usually moderately elongate, occasionally very short and wide or very elongate, usually shallowly concave dorsally, occasionally flat or shallowly grooved), Tetraonidae (blade moderately elongate, shallowly concave dorsally), Odontophoridae (blade very elongate, deeply grooved dorsally).

(9) Increasing pneumaticity of the proximal end of the humerus including enlargement of the pneumatic fossa, obliteration of its inner shelf, and development of fossa II:

Cracidae (pneumatic fossa very small; inner shelf present; fossa II absent), Numididae and Meleagrididae (pneumatic fossa small; inner shelf present; fossa II indistinct), Tetraonidae (pneumatic fossa moderately enlarged; usually without, occasionally with inner shelf; fossa II indistinct), Phasianidae (pneumatic fossa usually moderately large, occasionally much enlarged; usually with, occasionally without inner shelf; fossa II usually indistinct, occasionally well developed), Odontophoridae (pneumatic fossa much enlarged; usually without inner shelf, occasionally with inner shelf; fossa II usually well developed, occasionally indistinct).

(10) Enlargement of the pisiform process on the carpometacarpus: Cracidae and Tetraonidae (process indistinct), Numididae (process indistinct or produced medially), Phasianidae (process usually produced medially, occasionally indistinct), Meleagrididae and Odontophoridae (process produced medially).

(11) Loss or enlargement of intermetacarpal tubercle of carpometacarpus: Cracidae (tubercle a minute point), Numididae (tubercle absent), Phasianidae (tubercle usually well developed, occasionally weakly developed), Meleagrididae, Phasianidae, Tetraonidae, and Odontophoridae (tubercle well developed).

(12) Loss of pneumaticity of anterior portion of renal depression of pelvis: Cracidae and Numididae (depression

with large pneumatic fossa), Phasianidae (depression usually with pneumatic foramina, occasionally non-pneumatic), Tetraonidae (depression usually non-pneumatic, occasionally with pneumatic foramina), Meleagrididae and Odontophoridae (renal depression non-pneumatic).

(13) Development of a distal extension of inner calcaneal ridge, and spur core on posterior shaft of tarsometatarsus: Cracidae, Numididae, and Odontophoridae (ridge without distal extension; shaft without spur core), Tetraonidae (ridge usually with, occasionally without, distal extension; shaft without spur core), Phasianidae (ridge usually with, occasionally without; distal extension; shaft usually with spur core in the male, occasionally with rudimentary spur core or without spur core), Meleagrididae (ridge with distal extension; shaft with spur core in the male).

Among the above characters, the Meleagrididae show the primitive condition in four instances, the Numididae in three instances, and the Tetraonidae and Odontophoridae in only one instance. The Phasianidae do not show the primitive condition. The Phasianidae are intermediate in all characters, the Numididae in nine, the Tetraonidae in six, the Meleagrididae in three, and the Odontophoridae in two. The Odontophoridae show the advanced condition in 10 instances, the Tetraonidae and Meleagrididae in six instances, the Phasianidae in three instances, and the

Numididae only once. Thus the New World quail appear to represent a highly specialized, possibly the most highly evolved group within the Galli.

It should be pointed out here that a very interesting parallel in the trend towards enlargement of the pneumatic fossa and fossa II of the humerus is found in the Passeriformes (Ashley, 1941). The main difference in the trend in the Passeriformes and in the Galli is that the former group has progressed much farther. In the most highly evolved passerines the medial bar has become so eroded that the two fossae become continuous distally below the remnant of the bar.

Status of the Odontophoridae and Phasianidae.--There has been much criticism of the taxonomic status of the Phasianidae of Wetmore. Delacour (1951) points out that the pheasants are "a group of game birds which do not differ from others by very well-defined or important characteristics." Sibley (1960) remarks that "The inclusion of quails, partridges, and francolins in the subfamily makes it a diverse group which is exceedingly difficult to define," and on the basis of electrophoretic patterns of egg-white proteins believes that the New World quail may represent a separate subfamily. The status of the Old World quail of the subfamily Perdicinae is less clear. The Perdicinae show on one hand basic resemblances to the pheasants, but on the other hand some of the same trends in modification of skeletal structures found in the New World quail, possibly through parallel evolution in the Old and New World birds. The Perdicinae are here retained as a subfamily of the Phasianidae, although this greatly increases the osteological heterogeneity of the family. Skeletal characters that separate the Odontophoridae (New World quail) from the Phasianidae (Old World quail and pheasants) include the following:

In the rostrum, (1) Odontophoridae, rostrum short, deep, and strongly decurved; Phasianidae, rostrum long, shallow, and slightly decurved.

In the sternum, (1) Odontophoridae, manubrial spine without dorsal foramen; Phasianidae, manubrial spine often with dorsal foramen.

In the coracoid, (1) Odontophoridae, dorsal intermuscular line sharply raised distally; Phasianidae, dorsal intermuscular line usually not raised, or only slightly raised distally. (2) Odontophoridae, ventral intermuscular line terminating at tip of sterno-coracoidal process or occasionally in middle of distal border of sternal facet; Phasianidae, ventral intermuscular line often terminating near lateral end of sternal facet. (3) Odontophoridae, distal dorsal face non-pneumatic; Phasianidae, distal dorsal face usually with a large pneumatic fossa.
(4) Odontophoridae, sterno-coracoidal process usually terminating in a well developed terminal knob; Phasianidae,

sterno-coracoidal process usually terminating in an obsolete terminal knob.

In the scapula, (1) Odontophoridae, scapular blade very elongate, with its dorsal surface deeply grooved throughout, and with its apex expanding terminally; Phasianidae, scapular blade with much variation in shape, but never as in Odontophoridae.

In the humerus, (1) Odontophoridae, pneumatic fossa much enlarged with inner shelf only in one species of *Odontophorus*; Phasianidae, pneumatic fossa usually moderately large, usually with inner shelf extending from medial bar to internal bicipital surface. (2) Odontophoridae, fossa II usually well developed; Phasianidae, fossa II usually obsolete.

In the pelvis, (1) Odontophoridae, pectineal process obsolete; Phasianidae, pectineal process well developed, long, and narrow (*Pavo cristatus* is a single exception, and has the pectineal process obsolete, whereas it is well developed, long, and narrow in *Pavo muticus*). (2) Odontophoridae, renal bar non-pneumatic; Phasianidae, renal bar often with a pneumatic foramen.

In the tarsometatarsus, (1) Odontophoridae, hypotarsus usually with two closed calcaneal canals; Phasianidae, hypotarsus with one closed calcaneal canal. (2) Odontophoridae, inner calcaneal ridge without distal extension; Phasianidae, inner calcaneal ridge usually with distal extension that extends two-thirds the way down the shaft.

(3) Odontophoridae, posterior shaft without spur core; Phasianidae, posterior shaft usually with spur core, or rudimentary spur core in the male.

OSTEOLOGY OF LIVING NEW WORLD QUAIL

Osteological evidence presented in the previous section indicates that the New World quail represent a natural and highly evolved group of galliform birds that should be recognized as a family, the Odontophoridae, rather than as a subfamily of the Phasianidae.

The next phase of the present work includes an osteological account of the living genera and species of New World quail available for study, as well as remarks on skeletal variation in some subspecies of Colinus virginianus. This section was undertaken with two purposes in mind, namely: (1) to clarify the relationships of the Recent forms, and (2) to become acquainted with skeletal variation at the generic, specific, and subspecific level in Recent forms, before attempting to deal with the fossil material.

The skeletal elements studied for the following account are the same as those in the preceding section, and are those bones most frequently found as fossils.

Dendrortyx Gould 1844

This genus includes four living species, confined to the mountains of Mexico and Central America. Only a single skeleton of Dendrortyx leucophrys (Gould 1844) was available. Its measurements are given in Table 7.

Rostrum.--(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.--(3) Height of carina through sternal plate 30 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus projected well beyond ventral lip. (5) Depressions on anterior portion of sternal plate shallow and slightly pneumatic. (6) Base of posterior lateral process more than one-half width of sternal plate at its middle.

Coracoid.--(7) Entire proximal end bending ventrad above level of procoracoid process. (8) Head broadly rounded, much depressed, and much inflected. (9) Brachial tuberosity with moderate dorsal, but slight ventral overhang. (10) Furcular facet weakly inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft narrow proximally, with distal portion of its ventral surface convex medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to lateral border of shaft, with distal fifth sharply raised. (15) Ventral intermuscular line terminating in middle of distal border of sterno-coracoidal process. (16) Dorsal face weakly excavated, distally, but with distinct round, deep, fossa below tubercle for ligamentum sterno-coracoideum dorsale, and above external end of sternal facet. (17) Tubercle for ligamentum sterno-coracoideum dorsale obsolete, but rounded. (18) Internal distal angle without distinct tubercle or ridge on dorsal face. (19) Sterno-coracoidal process with distal margin strongly oblique, not produced as a sharply raised ridge, but grooved dorsally; with its tip directed proximally, but without a terminal knob. (20) Distal border of sternal facet very shallowly concave.

Scapula.--(21) Glenoid facet elliptical in dorsal view. (22) Dorsal depression just mediad to glenoid facet deeply excavated. (23) Bridge between acromion process and glenoid facet about one-half width of glenoid facet. (24) Acromion process with its apex acute and slightly deflected.

Humerus.--(25) Pneumatic fossa a short oval, without inner shelf. (26) Median crest strongly developed, elevated throughout. (27) Capital groove deeply excavated, with its internal margin strongly elevated. (28) Margin between head and internal tuberosity only slightly concave. (29) Head about as long as broad in anconal view. (30) Ridge along medial border of fossa II slightly swollen, elongate, and with its apex acute. (31) Fossa II obsolete. (32) Latissimus ridge (Ashley, 1941) extending along lateral edge of shaft throughout its length. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, rounded, and with its distal border lacking a groove. (35) Deltoid crest strongly developed, much inflected, and with its summit knob-like. (36) Entepicondyle at level of internal condyle. (37) Entepicondylar prominence weakly produced, with its pit placed on internal face. (38) Depression of M. brachialis anticus deeply excavated. (39) Distal border of external condyle flat in anconal view.

Ulna.--(40) Olecranon process strongly produced, and with its apex rounded. (41) External cotyla shortened, flattened dorsally, with its distal border sloping precipitously into shaft, and deeply notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 83 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression well excavated. (45) Notch between carpal tuberosity and internal condyle weak. (46) External condyle weakly produced, arising abruptly from shaft, and with its ventral border flattened.

Carpometacarpus.--(47) Metacarpal I moderately pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process very weak, and extending only slightly onto base of metacarpal I. (49) Pisiform process round in internal view, much reflected dorsad, thus produced well above dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced throughout, moderately swollen proximally and distally, with proximal portion separated from pisiform process by shallow sulcus. (51) Internal carpal trochlea with its proximal border shallowly concave, and its ventral border slightly notched. (52) Intermetacarpal tubercle extending to and ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III obsolete. (54) With one moderately developed and one obsolete tubercle on external proximal face of metacarpal III. (55) Metacarpal III moderately bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 51 per cent length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only moderately produced beyond acetabular border, and with its apex rounded. (58) Depression on medial side of pectineal process deeply excavated, and perforated by a foramen. (59) Posterior iliac crest without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence sharply arising from its posterior portion. (61) Dorsal face of post-acetabular ilium moderately broad anteriad, narrowing abruptly posteriad to form acute apex of short, broad, dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium enlarged, triangular, and vertical in position, with its posterodorsal apex forming posteromedial wall of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming shortened lateral wall of posterior process. (64) Renal bar very slender, with both bar and posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse processes of fourth synsacral vertebra 55 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.---(67) Distal width 17 per cent length (Table 5). (68) Head moderately enlarged, bent dorsally, and rotated posteriorly. (69) Neck long. (70) Iliac facet compressed, with posterior border straight. (71) Dorsal crest of trochanter depressed and deflected, with its dorsal border flat. (72) Trochanteric ridge 20 per cent length of femur. (73) Distal depth 85 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle depressed, and flattened anteriorly.

Tibiotarsus.---(76) Depth of inner cnemial crest 59 per cent of its length (Table 4). (77) Outer cnemial crest decurved. (78) Interarticular tubercle moderately produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surfaces weakly notched. (81) Area just anterior to ridge from proximal internal ligamental attachment with deeply excavated depression. (82) Internal ligamental prominence on internal condyle strongly produced. (83) Face of internal condyle well excavated, with its border highly elevated. (84) Dorsal border of supratendinal bridge oblique.

Tarsometatarsus.---(85) Distal width 14 per cent of length (Table 6). (86) Proximal depth 94 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex pointed. (88) Posterior intercotylar area moderately excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen deeply excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and one closed calcaneal canal. (91) Anterior face of shaft extensively excavated by anterior metatarsal groove. (92) Depth of middle trochlea 56 per cent of distal width. (93) Trochlea for digit II only slightly inflected. (94) Wing of trochlea for digit IV depressed anteroposteriorly, thus entire trochlea slightly longer than deep.

Intermembral proportions.---(95) Wing/leg 52 per cent (Table 2). (96) Ulna/humerus 88 per cent. (97) Tarsometatarsus/femur 88 per cent. (98) Tarsometatarsus/tibiotarsus 63 per cent. (99) Humerus/femur 71 per cent. (100) Humerus/tibiotarsus 51 per cent. (101) Ulna/femur 63 per cent. (102) Ulna/tibiotarsus 45 per cent. (103) Ulna/tarsometatarsus 72 per cent. (104) Carpometacarpus/femur 37 per cent. (105) Carpometacarpus/tibiotarsus 27 per cent. (106) Carpometacarpus/tarsometatarsus 42 per cent. (107) Tarsometatarsus/humerus 124 per cent. (108) Ilium/sternum 89 per cent. (109) Height of sternal carina/ilium 34 per cent.

Philortyx Gould 1846

This monotypic genus is confined to the mountains of Mexico. Measurements of Philortyx fasciatus (Gould 1844) are given in Table 7.

Rostrum.---(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.---(3) Sternum incomplete. (4) Dorsal lip of coracoidal sulcus projected well beyond ventral lip. (5) Depressions on anterior portion of sternal plate deep and slightly pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.---(7) Entire proximal end straight above procoracoid process. (8) Head pointed, much compressed, and much reflected. (9) Brachial tuberosity obsolete dorsally, but with moderate ventral overhang. (10) Furcular facet weakly inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft wide proximally, with distal portion of its ventral surface concave medially. (13) Procoracoid process with its apex acute.

(14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (16) Dorsal face weakly excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale well developed, and rounded. (18) Internal distal angle with distinct dorsal ridge extending obliquely to above lateral end of sternal facet. (19) Sterno-coracoidal process with distal margin moderately oblique, not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in an obsolete terminal knob. (20) Distal border of sternal facet shallowly concave.

Scapula.--(21) Glenoid facet oval in dorsal view. (22) Dorsal depression just mediad to glenoid facet shallowly excavated. (23) Bridge between acromion process and glenoid facet about one-third width of glenoid facet. (24) Acromion process with its apex rounded and moderately deflected.

Humerus.--(25) Pneumatic fossa a moderately long ellipse, without inner shelf. (26) Median crest weakly developed, but elevated throughout. (27) Capital groove deeply excavated, with its internal margin strongly elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head about as long as broad in anconal view. (30) Ridge along medial border of fossa II slightly swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, pointed, and with its distal border lacking a groove. (35) Deltoid crest moderately developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle produced slightly beyond level of internal condyle. (37) Entepicondylar prominence moderately produced, with its pit placed on internal face. (38) Depression for M. brachialis anticus deeply excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, and with its apex pointed. (41) External cotyla moderately elongate, rounded throughout, with its distal border sloping gently into shaft, and deeply notched by proximal radial impression. (42) Impression for M. brachialis anticus represented by an unexcavated scar, with its borders indistinct. (43) Height at middle of shaft 85 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle well produced, arising abruptly from shaft, and with its ventral border flattened.

Carpometacarpus.--(47) Metacarpal I moderately pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process round in internal view, moderately reflected dorsad, thus produced slightly above dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and moderately swollen proximally, flattened distally, with proximal portion connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border shallowly concave, and its ventral border without notch. (52) Intermetacarpal tubercle extending slightly beyond, but not ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III elongate and weakly produced. (54) With only one moderately developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 47 per cent length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only moderately produced beyond acetabular border, and with its apex pointed. (58) Depression on medial side of pectineal process deeply excavated, but without foramen. (59) Posterior iliac crest without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence sharply arising from its posterior portion. (61) Dorsal face of post-acetabular ilium moderately broad anteriad, narrowing abruptly posteriad to form acute apex of short, broad, dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium enlarged, triangular, and vertical in position, with its posterodorsal apex forming posteromedial wall of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming shortened lateral wall of posterior process. (64) Renal bar moderately slender, with both bar and posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse process of fourth synsacral vertebra 60 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra (Table 3).

Femur.--(67) Distal width 14 per cent of length (Table 5). (68) Head moderately enlarged neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter compressed and reflected, with its dorsal border rounded. (72) Trochanteric ridge 27 per cent length of femur. (73) Distal depth 97 per cent of distal width. (74) Internal condyle very wide, and with its anterior border moderately produced throughout. (75) External condyle compressed and rounded anteriorly.

Tibiotarsus.---(76) Depth of inner cnemial crest about 45 per cent of its length (Table 4). (77) Outer cnemial crest decurved. (78) Interarticular tubercle weakly produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge from proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge straight.

Tarsometatarsus.---(85) Distal width 17 per cent of length (Table 6). (86) Proximal depth 86 per cent of proximal width. (87) Intercotylar prominence much deflected, and with its apex pointed. (88) Posterior intercotylar area weakly excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen deeply excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and two closed calcaneal canals. (91) Anterior face of shaft extensively excavated by anterior metatarsal groove.

(92) Depth of middle trochlea 59 per cent of distal width.

(93) Trochlea for digit II only slightly inflected.

(94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.---(95) Wing/leg 65 per cent (Table 2). (96) Ulna/humerus 87 per cent. (97) Tarsometatarsus/femur 76 per cent. (98) Tarsometatarsus/tibiotarsus 59 per cent. (99) Humerus/femur 82 per cent. (100) Humerus/tibiotarsus 64 per cent. (101) Ulna/femur 72 per cent. (102) Ulna/tibiotarsus 55 per cent. (103) Ulna/tarsometatarsus 94 per cent. (104) Carpometacarpus/femur 44 per cent. (105) Carpometacarpus/tibiotarsus 34 per cent. (106) Carpometacarpus/tarsometatarsus 58 per cent. (107) Tarsometatarsus/humerus 93 per cent. (108) Ilium/sternum 41 per cent. (109) Height of sternal carina/ilium 41 per cent.

Oreortyx Baird 1858

The monotypic genus Oreortyx occurs from Washington to northern Baja, California. Measurements of O. picta (Douglas 1829) are given in Table 7.

Rostrum.---(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.---(3) Height of carina through sternal plate 29-31 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus projected well beyond ventral lip.

(5) Depressions on anterior portion of sternal plate deep and moderately pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.---(7) Entire proximal end straight above procoracoid process. (8) Head broadly rounded, moderately depressed, and moderately reflected. (9) Brachial tuberosity with slight dorsal and ventral overhang. (10) Furcular facet moderately inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft wide proximally, with distal portion of its ventral surface concave medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (16) Dorsal face weakly excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale well developed, but irregular in outline. (18) Internal distal angle with distinct irregular tubercle extending obliquely to above lateral end of sternal facet. (19) Sterno-coracoidal process with distal margin slightly oblique, not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet deeply concave.

Scapula.---(21) Glenoid facet oval in dorsal view.

(22) Dorsal depression just mediad to glenoid facet shallowly to moderately excavated. (23) Bridge between acromion process and glenoid facet about one-half width of glenoid facet. (24) Acromion process with its apex acute and slightly deflected.

Humerus.--(25) Pneumatic fossa a moderately long oval or ovaloid, without inner shelf. (26) Median crest strongly developed, elevated only at its middle. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II much swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity much inflated. (34) Bicipital crest arising gently from shaft, pointed, and with its distal border lacking a groove. (35) Deltoid crest moderately developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle at level of internal condyle. (37) Entepicondylar prominence moderately produced, with its pit placed on internal face. (38) Depression of M. brachialis anticus shallowly excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, with its apex pointed. (41) External cotyla much elongated, rounded throughout, with its distal border sloping gently into shaft and, only slightly notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 64-70 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle moderately produced, arising gently from shaft, and rounded throughout.

Carpometacarpus.--(47) Metacarpal I sharply pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process ovaloid in internal view, slightly reflected dorsad, thus below level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and much swollen proximally, flattened distally, with proximal portion connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border distinctly concave, and its ventral border slightly notched. (52) Intermetacarpal tubercle extending slightly beyond, but not ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III elongate and moderately produced. (54) With one strongly developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 60-63 per cent of length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only moderately produced beyond acetabular border, and with its apex pointed. (58) Depression on medial side of pectineal process shallowly excavated, and without foramen. (59) Posterior iliac crest without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence weakly arising from its posterior portion. (61) Dorsal face of post-acetabular ilium much broadened anteriad, narrowing abruptly posteriad to form acute apex of very short, broad dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium enlarged, broadly triangular, and vertical in position, with its posterodorsal apex forming posteromedial wall of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming shortened lateral wall of posterior process. (64) Renal bar obsolete, with both bar and posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse process of fourth synsacral vertebra 67-85 per cent length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.--(67) Distal width about 17 per cent length (Table 5). (68) Head moderately enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter compressed and reflected, with its dorsal border rounded. (72) Trochanteric ridge 23-25 per cent length of femur. (73) Distal depth 76-83 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.--(76) Depth of inner cnemial crest 65-74 per cent of its length (Table 4). (77) Outer cnemial crest straight. (78) Interarticular tubercle strongly produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge from proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge usually straight.

Tarsometatarsus.--(85) Distal width 17-18 per cent of length (Table 6). (86) Proximal depth 91-98 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex usually pointed. (88) Posterior intercotylar area usually unexcavated, but may be weakly excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen shallowly excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and usually one, sometimes two, closed calcaneal canals. (91) Anterior metatarsal groove reduced or absent. (92) Depth of middle trochlea 50-53 per cent of distal width. (93) Trochlea for digit II moderately inflected. (94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.--(95) Wing/leg 67-67 per cent (Table 2). (96) Ulna/humerus 92-94 per cent. (97) Tarsometatarsus/femur 75-82 per cent. (98) Tarsometatarsus/tibiotarsus 58 per cent. (99) Humerus/femur 83-89 per cent. (100) Humerus/tibiotarsus 58-61 per cent. (101) Ulna/femur 78-82 per cent. (102) Ulna/tibiotarsus 55-58 per cent. (103) Ulna/tarsometatarsus 95-110 per cent. (104) Carpometacarpus/femur 47-50 per cent. (105) Carpometacarpus/tibiotarsus 33-35 per cent. (106) Carpometacarpus/tarsometatarsus 57-66 per cent. (107) Tarsometatarsus/humerus 85-99 per cent. (108) Ilium/sternum 65-69 per cent.

(109) Height of sternal carina/ilium 45-46 per cent.

Callipepla Wagler 1832

The single species, Callipepla squamata (Vigors 1830) occurs in the southwestern United States and northern Mexico. Measurements are given in Table 7.

Rostrum.--(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.--(3) Height of carina through sternal plate 30-31 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus projected well beyond ventral lip. (5) Depressions on anterior portion of sternal plate obsolete to deep and slightly to moderately pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.--(7) Entire proximal end straight above procoracoid process. (8) Head narrowly rounded, moderately compressed, and moderately inflected. (9) Brachial tuberosity with slight dorsal and ventral overhang. (10) Furcular facet moderately inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft wide proximally, with distal portion of its ventral surface usually concave medially. (13) Procoracoid process with its apex acute. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (16) Dorsal face weakly excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale obsolete, but rounded. (18) Internal distal angle with distinct irregular tubercle extending obliquely to above lateral end of sternal facet. (19) Sterno-coracoidal process with distal margin slightly oblique, not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet usually deeply concave.

Scapula.--(21) Glenoid facet oval in dorsal view. (22) Dorsal depression just mediad to glenoid facet unexcavated, shallowly excavated or moderately excavated. (23) Bridge between acromion process and glenoid facet about one-half width of glenoid facet. (24) Acromion process with its apex rounded, and slightly deflected.

Humerus.--(25) Pneumatic fossa a moderately long oval or ovaloid, without inner shelf. (26) Median crest usually weakly developed, elevated only at its middle. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II moderately swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, narrowly rounded, and with its distal border lacking a groove. (35) Deltoid crest moderately developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle at level of internal condyle. (37) Entepicondylar prominence moderately produced, with its pit placed on palmar face. (38) Depression of M. brachialis anticus usually shallowly excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, and with its apex pointed. (41) External cotyla moderately elongate, rounded throughout, with its distal border sloping gently into shaft, and only slightly notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 63-66 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle well produced, arising abruptly from shaft, and rounded throughout.

Carpometacarpus.--(47) Metacarpal I moderately pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process round or ovaloid in internal view, slightly reflected dorsad, thus usually below, occasionally at level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and much swollen proximally, flattened distally, with proximal portion connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border deeply notched, and its ventral border without notch. (52) Intermetacarpal tubercle extending to, but not ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III obsolete. (54) With one strongly developed tubercle on external proximal face of metacarpal III, (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 58-62 per cent of length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only moderately produced beyond acetabular border, and with its apex pointed. (58) Depression on medial side of pectineal process shallowly excavated, and without foramen. (59) Posterior iliac crest without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence weakly arising from its posterior portion. (61) Dorsal face of post-acetabular ilium moderately broad anteriad, narrowing abruptly posteriad to form acute apex of short, broad, dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium enlarged, triangular, and vertical in position, with its posterodorsal apex forming posteromedial wall of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming shortened lateral wall of posterior process. (64) Renal bar very slender, with both bar and posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse process of fourth synsacral vertebra 71-80 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.--(67) Distal width 17-18 per cent of length (Table 5). (68) Head moderately enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter compressed and reflected, with its dorsal border rounded. (72) Trochanter ridge 24 per cent length of femur. (73) Distal depth 76-82 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle compressed and rounded anteriorly.

Tibiotarsus.--(76) Depth of inner cnemial crest 64-73 per cent of its length (Table 4). (77) Outer cnemial crest usually straight. (78) Interarticular tubercle moderately produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surfaces with a distinct notch. (81) Area just anterior to ridge from proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge straight.

Tarsometatarsus.---(85) Distal width 15-18 per cent of length (Table 6). (86) Proximal depth 95-98 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex usually pointed. (88) Posterior intercotylar area weakly excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen shallowly excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and two closed calcaneal canals. (91) Anterior face of shaft moderately excavated by anterior metatarsal groove. (92) Depth of middle trochlea 52-59 per cent of distal width. (93) Trochlea for digit II only slightly inflected. (94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.---(95) Wing/leg 67-69 per cent (Table 2). (96) Ulna/humerus 92 per cent. (97) Tarsometatarsus/femur 79-82 per cent. (98) Tarsometatarsus/tibiotarsus 59 per cent. (99) Humerus/femur 85-89 per cent. (100) Humerus/tibiotarsus 63-65 per cent. (101) Ulna/femur 78-82 per cent. (102) Ulna/tibiotarsus 58-59 per cent. (103) Ulna/tarsometatarsus 95-102 per cent. (104) Carpometacarpus/femur 47-48 per cent. (105) Carpometacarpus-tibiotarsus 34-35 per cent. (106) Carpometacarpus/tarsometatarsus 58-61 per cent. (107) Tarsometatarsus/humerus 89-96 per cent. (108) Ilium/sternum 66-69 per cent. (109) Height of sternal carina/ilium 43-47 per cent.

Colinus Goldfuss 1820

The genus Colinus occurs in the United States east of the Rockies, on Cuba and the Isle of Pines, and through Mexico and Central America to Colombia and Venezuela. There are four living species. Table 7 includes measurements of C. virginianus (Linnaeus 1758), C. nigrogularis (Gould 1843), and C. leucopogon (Lesson 1842).

Rostrum.--(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.--(3) Height of carina through sternal plate 25-32 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus projected well beyond ventral lip. (5) Depressions on anterior portion of sternal plate usually shallow and non-pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.--(7) Entire proximal end straight above procoracoid process. (8) Head narrowly rounded, moderately compressed, moderately reflected or inflected. (9) Brachial tuberosity with slight dorsal and ventral overhang. (10) Furcular facet weakly or moderately inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft wide proximally, with distal portion of its ventral surface concave medially. (13) Procoracoid process with its apex acute or rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (16) Dorsal face moderately excavated distally, and without distinct fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale obsolete or well developed, irregular in shape or rounded. (18) Internal distal angle without distinct tubercle or ridge on dorsal face. (19) Sterno-coracoidal process with distal margin slightly oblique, not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet usually deeply concave.

Scapula.--(21) Glenoid facet oval in dorsal view. (22) Dorsal depression just mediad to glenoid facet moderately to deeply excavated. (23) Bridge between acromion process and glenoid facet less than one-third to about half width of glenoid facet. (24) Acromion process with its apex rounded, and usually moderately deflected.

Humerus.--(25) Pneumatic fossa short to very long, elliptical, oval, or ovaloid, without inner shelf. (26) Median crest moderately to strongly developed, elevated only at its middle. (27) Capital groove usually moderately excavated, with its internal margin usually moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II slightly to moderately swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, usually narrowly rounded, and with its dorsal border lacking a groove. (35) Deltoid crest moderately developed slightly inflected, and with its summit flattened or knob-like. (36) Entepicondyle usually at level of internal condyle. (37) Entepicondylar prominence moderately produced, with its pit placed on internal face. (38) Depression of M. brachialis anticus usually moderately excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, and with its apex pointed. (41) External cotyla moderately elongate, rounded throughout, with its distal border sloping gently into shaft, and only slightly notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 62-71 per cent of height just distal to external cotyla. (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle well produced, arising abruptly from shaft, and rounded throughout.

Carpometacarpus.--(47) Metacarpal I moderately pointed or rounded terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process round, ovaloid, oval or elliptical in internal view, slightly reflected dorsad, thus usually below, occasionally at level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and much swollen proximally, flattened distally, with proximal portion usually connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border shallowly concave or slightly notched, and its ventral border without notch. (52) Intermetacarpal tubercle extending to or slightly beyond, but usually not ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III obsolete. (54) With one strongly developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 44-51 per cent of length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only moderately produced beyond acetabular border, and with its apex usually pointed. (58) Depression on medial side of pectineal process shallowly excavated, and without foramen. (59) Posterior iliac crest without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence sharply arising from its posterior portion. (61) Dorsal face of post-acetabular ilium moderately broad anteriad, narrowing abruptly posteriad to form acute apex of short, broad, dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium enlarged, triangular, and vertical in position, with its posterodorsal apex forming posteromedial wall of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming shortened lateral wall of posterior process. (64) Renal bar very slender, with both bar and posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse processes of fourth synsacral vertebra 57-68 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.--(67) Distal width 15-18 per cent of length (Table 5). (68) Head moderately enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter depressed and deflected or compressed and reflected, with its dorsal border flat or rounded. (72) Trochanteric ridge 21-25 per cent length of femur. (73) Distal depth 78-90 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.--(76) Depth of inner cnemial crest 54-69 per cent of its length (Table 4). (77) Outer cnemial crest usually straight. (78) Interarticular tubercle usually moderately produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge from proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge oblique or straight.

Tarsometatarsus.--(85) Distal width 16-19 per cent of length (Table 6). (86) Proximal depth 93-100 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex usually pointed. (88) Posterior intercotylar area weakly excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen shallowly excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and two closed calcaneal canals. (91) Anterior face of shaft usually moderately excavated by anterior metatarsal groove. (92) Depth of middle trochlea 52-60 per cent of distal width. (93) Trochlea for digit II only slightly inflected. (94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.--(95) Wing/leg 63-69 per cent (Table 2). (96) Ulna/humerus 86-91 per cent. (97) Tarsometatarsus/femur 73-83 per cent. (98) Tarsometatarsus/tibiotarsus 57-61 per cent. (99) Humerus/femur 82-88 per cent. (100) Humerus/tibiotarsus 62-66 per cent. (101) Ulna/femur 72-79 per cent. (102) Ulna/tibiotarsus 53-59 per cent. (103) Ulna/tarsometatarsus 92-104 per cent. (104) Carpometacarpus/femur 43-47 per cent. (105) Carpometacarpus/tibiotarsus 33-35 per cent. (106) Carpometacarpus/tarsometatarsus 55-62 per cent. (107) Tarsometatarsus/humerus

86-98 per cent. (108) Ilium/sternum 66-75 per cent. (109) Height of sternal carina/ilium 37-45 per cent.

Specific Variation in Colinus

Coracoid.---(1) Head usually moderately reflected (moderately inflected in *C. nigrogularis*). (2) Furcular facet moderately inflated (weakly inflated in *C. nigrogularis*). (3) Procoracoid process with its apex usually rounded (acute in *C. nigrogularis*). (4) Tubercle for ligamentum sterno-coracoideum dorsale usually obsolete and irregular in shape (well developed and round in *C. leucopogon*).

Scapula.---(5) Bridge between acromion process and glenoid facet usually about one-half width of glenoid facet (less than one-third width in *C. nigrogularis*).

Humerus.---(6) Pneumatic fossa usually moderately long (very long in *C. nigrogularis*). (7) Median crest moderately developed (usually strongly developed in *C. virginianus*). (8) Ridge along medial border of fossa II moderately swollen (slightly swollen in *C. nigrogularis*). (9) Deltoid crest with its apex flattened (usually knob-like in *C. virginianus*).

Carpometacarpus.---(10) Metacarpal I usually moderately pointed terminally (rounded terminally in *C. leucopogon*).

Femur.---(11) Dorsal crest of trochanter usually depressed and deflected with its dorsal border usually flat (usually compressed and reflected, dorsal border usually round in *C. leucopogon*).

Tibiotarsus.---(12) Dorsal border of supratendinal bridge usually oblique (straight in C. leucopogon).

Intermembral proportions.---Species of Colinus inseparable on intermembral proportions.

Remarks.---The skeletons of the Recent species of Colinus are very similar. Colinus virginianus resembles C. leucopogon in six of 12 characters, C. nigrogularis in four of 12 characters, and is unique in two characters (these are subject to some individual variation). Colinus nigrogularis resembles C. virginianus in four of 12 characters, C. leucopogon in two of 12 characters, and is unique in six characters. C. leucopogon resembles C. virginianus in six of 12 characters, C. nigrogularis in two of 12 characters and is unique in four characters.

Colinus virginianus averages largest, C. leucopogon second largest, and C. nigrogularis the smallest (Table 7).

Subspecific Variation in Colinus virginianus

United States populations of Recent Colinus virginianus show a gradual decrease in mean skeletal size from north to south (Table 8).

No qualitative skeletal differences separate the subspecies of Colinus virginianus, but one qualitative character appears to follow a similar north-south gradient. The Mexican samples are too small to indicate trends.

A north-south decrease in mean size occurs in United

States bob-whites. The Michigan population of *C. v. virginianus* is largest, and the Illinois population second largest in each of 20 measurements. North Florida quail, representing intergrades between *C. v. virginianus* and *C. v. floridanus*, are third largest in 19 of 20 measurements, whereas the peninsular subspecies *C. v. floridanus* is the smallest in 19 of 20 measurements.

It is difficult to make a positive statement about the size of the Mexican races of *C. virginianus* because of the small sample of these forms. However, both *C. v. insignis* from Chiapas, and *C. v. coyolcos* from Oaxaca are smaller than *C. v. virginianus* from Michigan and Illinois in all 20 measurements.

The development of the median crest of the humerus appears to show a north-south gradient in the subspecies of *C. virginianus* and thus is the only qualitative character that may be associated with any definite trend. In *C. v. virginianus* from Michigan 85 per cent of 20 specimens have the median crest strongly developed, while 15 per cent are moderately or weakly developed. In *C. v. virginianus* from southern Illinois 71 per cent of 38 specimens have the median crest strongly developed, while 29 per cent are moderately or weakly developed. In intergrades between *C. v. virginianus* and *C. v. floridanus* from North Florida 38 per cent of 13 specimens have the median crest strongly developed, while 62 per cent are moderately or weakly developed. In C. v. floridanus from peninsular Florida 29 per cent of seven specimens have the median crest strongly developed, while 71 per cent are moderately or weakly developed. In C. v. insignis from Chiapas, Mexico, 40 per cent of five specimens have the median crest strongly developed, while 60 per cent are moderately developed. One specimen of C. v. coyolcos from Oaxaca, Mexico, has the median crest strongly developed.

Lophortyx Bonaparte 1838

The genus Lophortyx occurs in the western United States and western Mexico. Table 7 includes measurements of the three recognized species, L. californica (Shaw 1798), L. gambelii Gambel 1843, and L. douglasii (Vigors 1829).

Rostrum.---(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.---(3) Height of carina through sternal plate 28-31 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus projected well beyond ventral lip. (5) Depressions on anterior sternal plate obsolete or deep, slightly to moderately pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.---(7) Entire proximal end straight above procoracoid process. (8) Head narrowly rounded, moderately compressed, and moderately inflected. (9) Brachial tuberosity with slight dorsal and ventral overhang. (10) Furcular facet weakly inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft narrow or wide proximally, with distal portion of its ventral surface convex or concave medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (16) Dorsal face weakly or moderately excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale obsolete or well developed, and round. (18) Internal distal angle without distinct tubercle or ridge on dorsal face. (19) Sterno-coracoidal process with distal margin slightly oblique, not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet deeply to very deeply concave.

Scapula.--(21) Glenoid facet oval in dorsal view. (22) Dorsal depression just mediad to glenoid facet shallowly to moderately excavated. (23) Bridge between acromion process and glenoid facet about one-half to more than one-half width of glenoid facet. (24) Acromion process with its apex rounded and usually slightly deflected.

Humerus.--(25) Pneumatic fossa a short to moderately long oval or ellipse, without inner shelf. (26) Median crest weak to strongly developed, elevated throughout or only at its middle. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head as broad as long or broader than long in anconal view. (30) Ridge along medial border of fossa II moderately swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, narrowly rounded, and with its distal border lacking a groove. (35) Deltoid crest moderately developed, slightly inflected, and with its summit usually flattened. (36) Entepicondyle produced slightly beyond internal condyle. (37) Entepicondylar prominence moderately produced, with its pit placed on internal face. (38) Depression of M. brachialis anticus moderately excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, with its apex pointed. (41) External cotyla moderately elongate, rounded throughout, with its distal border sloping gently into shaft, and usually only slightly notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 61-72 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle well produced, arising gently from shaft, and rounded throughout.

Carpometacarpus.--(47) Metacarpal I moderately pointed or rounded terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process ovaloid in internal view, slightly or moderately reflected dorsad, thus below, at, or slightly above level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and much swollen proximally, flattened distally, with proximal portion usually connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border usually slightly notched, and its ventral border without notch. (52) Intermetacarpal tubercle extending to and sometimes ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III obsolete. (54) With one strongly developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 54-57 per cent of length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only moderately produced beyond acetabular border, and with its apex pointed. (58) Depression on medial side of pectineal process shallowly excavated, and without foramen. (59) Posterior iliac crest without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence sharply arising from its posterior portion. (61) Dorsal face of post-acetabular ilium moderately broad anteriad, narrowing abruptly posteriad to form acute apex of short, broad, dorsal roof of posterior process. (62) Caudal face of post-acetabular enlarged, triangular, and vertical in position, with its posterodorsal apex forming posteromedial wall of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming shortened lateral wall of posterior process. (64) Renal bar very slender, with both bar and posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse process of fourth synsacral vertebra 67-76 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.--(67) Distal width 17-18 per cent of length (Table 5). (68) Head moderately or much enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter usually compressed and reflected, with its dorsal border rounded. (72) Trochanteric ridge 24-25 per cent length of femur. (73) Distal depth 77-85 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.--(76) Depth of inner cnemial crest 58-67 per cent of its length. (77) Outer cnemial crest straight or decurved. (78) Interarticular tubercle moderately produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surfaces with a distinct notch. (81) Area just anterior to ridge from proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge usually straight.

Tarsometatarsus.--(85) Distal width 18-20 per cent of length (Table 6). (86) Proximal depth 93-100 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex pointed. (88) Posterior intercotylar area usually weakly excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen shallowly excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and two closed calcaneal canals. (91) Anterior metatarsal groove usually reduced. (92) Depth of middle trochlea about 51-57 per cent of distal width. (93) Trochlea for digit II only slightly inflected. (94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.--(95) Wing/leg 60-66 per cent (Table 7). (96) Ulna/humerus 86-89 per cent. (97) Tarsometatarsus/femur 76-82 per cent. (98) Tarsometatarsus/tibiotarsus 57-59 per cent. (99) Humerus/femur 79-85 per cent. (100) Humerus/tibiotarsus 58-65 per cent. (101) Ulna/femur 68-74 per cent. (102) Ulna/tibiotarsus 50-56 per cent. (103) Ulna/tarsometatarsus 87-97 per cent. (104) Carpometacarpus/femur 37-45 per cent. (105) Carpometacarpus/tibiotarsus 31-35 per cent. (106) Carpometacarpus/tarsometatarsus 54-60 per cent. (107) Tarsometatarsus/humerus 89-99 per cent. (108) Ilium/sternum 66-70 per cent. (109) Height of sternal carina/ilium 42-45 per cent.

Specific Variation in *Lophortyx*

In this section when two of the three species agree in a particular character, the usual condition is mentioned first, followed by the exception shown in the third species.

Sternum.--(1) Depressions on anterior portion of sternal plate deep (obsolete in L. californica); slightly to moderately pneumatic in L. douglasii, slightly pneumatic in L. californica, moderately pneumatic in L. gambelii.

Coracoid.--(2) Shaft wide proximally (narrow proximally in L. californica), with distal portion of its ventral surface concave medially (convex medially in L. gambelii). (3) Dorsal face weakly excavated distally (moderately excavated distally in L. douglasii). (4) Tubercle for ligamentum sterno-coracoideum dorsale well developed (obsolete in L. californica). (5) Distal border of sternal facet deeply concave (very deeply concave in L. gambelii).

Scapula.--(6) Dorsal depression just mediad to glenoid facet shallowly to moderately excavated in L. douglasii, shallowly excavated in L. californica, moderately excavated in L. gambelii. (7) Bridge between acromion process and glenoid facet about one-half width of glenoid facet (more than one-half width of glenoid facet in L. gambelii).

Humerus.--(8) Combined proximal width, middle shaft width, and distal width 58-59 per cent of length (60-63 per cent of length in L. Californica). (9) Proximal width 27 per cent of length (28-30 per cent of length in L. californica). (10) Median crest strongly developed, elevated only at its middle (weak and elevated throughout in L. douglasii). (11) Head broader than long in anconal view (as broad as long in L. gambelii).

Ulna.--(12) Height at middle of shaft 67-72 per cent of height just distal to external cotyla (61 per cent of height in L. gambelii).

Carpometacarpus.---(13) Proximal width through pisiform process 65-67 per cent of proximal height through metacarpal I (61-62 per cent of proximal height in L. californica). (14) Metacarpal I rounded terminally (moderately pointed terminally in L. californica). (15) Pisiform process slightly reflected dorsad, thus below level of dorsal rim of inner carpal trochlea (moderately reflected dorsad, thus at or slightly above dorsal rim of inner carpal trochlea in L. gambelii). (16) Intermetacarpal tubercle usually extending to and ankylosing with metacarpal III (extending to, but not ankylosing with metacarpal III in L. douglasii).

Femur.--(17) Head moderately large (much enlarged in L. gambelii).

Tibiotarsus.---(18) Proximal depth 76-77 per cent of proximal width (72-73 per cent of proximal width in L. californica). (19) Outer cnemial crest straight or slightly decurved in L. californica, straight in L. douglasii, decurved in L. gambelii.

Intermembral proportions.---(20) Wing/leg 60-63 per cent (66 per cent in L. douglasii). (21) Femur/tibiotarsus 72-74 per cent (76-77 per cent in L. douglasii). (22) Tarsometatarsus/femur 76-79 per cent (82 per cent in L. gambelii). (23) Humerus/femur 83-85 per cent (79-80 per cent in L. californica). (24) Humerus/tibiotarsus 58-60 per cent

(64-65 per cent in *L. douglasii*). (25) Ulna/tibiotarsus 50-53 per cent (55-56 per cent in *L. douglasii*). (26) Ulna/tarsometatarsus 87-90 per cent (97 per cent in *L. douglasii*). (27) Carpometacarpus/femur 45 per cent (37-42 per cent in *L. californica*). (28) Carpometacarpus/tibiotarsus 31-32 per cent (34-35 per cent in *L. douglasii*). (29) Carpometacarpus/tarsometatarsus 54-56 per cent (59-60 per cent in *L. douglasii*). (30) Tarsometatarsus/humerus 98-99 per cent (89-90 per cent in *L. douglasii*).

Remarks.---On the basis of the samples studied, the skeletons of the Recent species of *Lophortyx* show more interspecific differences than do those of Recent species of *Colinus*. *Lophortyx californica* resembles *L. gambelii* in 11 of 30 characters, *L. douglasii* in eight of 30 characters, and is unique in 11 characters. *Lophortyx gambelii* resembles *L. californica* in 11 of 30 characters, *L. douglasii* in 10 of 30 characters, and is unique in nine characters. *L. douglasii* resembles *L. californica* in eight of 30 characters, *L. gambelii* in 10 of 30 characters, and is unique in 12 of 30 characters.

Lophortyx californica and *L. gambelii* are similar in size, but *L. douglasii* averages somewhat smaller in most measurements (Table 7).

Odontophorus Vieillot 1816

The genus *Odontophorus* is confined to tropical America.

Sixteen species are recognized, of which O. gujanensis (Gmelin 1789), O. stellatus (Gould 1843), and O. guttatus (Gould 1838) were examined. Table 7 includes measurements of these species.

Rostrum.---(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.---(3) Height of carina through sternal plate 29-33 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus projected slightly, or well beyond ventral lip. (5) Depressions on anterior portion of sternal plate obsolete and non-pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.---(7) Entire proximal end straight above procoracoid process. (8) Head narrowly rounded, moderately compressed, and moderately reflected or inflected. (9) Brachial tuberosity with slight or moderate dorsal, and slight ventral overhang. (10) Furcular facet much inflated. (11) Bicipital attachment well developed with margin between it and head concave. (12) Shaft wide proximally, with distal portion of its ventral surface concave medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft with distal two-thirds or distal three-fourths sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoidal process. (16) Dorsal face moderately or deeply excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale obsolete and irregular in shape. (18) Internal distal angle without distinct tubercle or ridge on dorsal face. (19) Sterno-coracoidal process with distal margin slightly oblique not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet shallowly or deeply concave.

Scapula.--(21) Glenoid facet oval or elliptical in dorsal view. (22) Dorsal depression just mediad to glenoid facet shallowly to deeply excavated. (23) Bridge between acromion process and glenoid facet usually about one-half width of glenoid facet. (24) Acromion process with its apex rounded and slightly or moderately deflected.

Humerus.--(25) Pneumatic fossa short to moderately long, oval or elliptical, without inner shelf, or with perforated inner shelf extending from external bicipital surface to medial bar. (26) Median crest strongly or very strongly developed, elevated throughout. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II moderately swollen, elongate, and with its apex acute. (31) Fossa II obsolete. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity slightly, moderately, or much inflated. (34) Bicipital crest arising gently from shaft, rounded, and with its distal border lacking a groove. (35) Deltoid crest moderately or strongly developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle produced slightly beyond level of internal condyle. (37) Entepicondylar prominence much produced, with its pit placed on internal face. (38) Depression of M. brachialis anticus moderately excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, and with its apex pointed. (41) External cotyla moderately elongate, rounded throughout or flattened dorsally, with its distal border sloping gently or precipitously into shaft, and slightly or deeply notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 65-72 per cent of height just distal to external cotyla. (44) Distal radial impression obsolete or moderately excavated. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle well produced, arising abruptly from shaft, and rounded throughout.

Carpometacarpus.--(47) Metacarpal I moderately pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process ovaloid in internal view, slightly reflected dorsad, thus slightly below level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and moderately or much swollen proximally, flattened distally, with proximal portion either connected to pisiform process by bony bridge or separated from pisiform process by shallow sulcus. (51) Internal carpal trochlea with its proximal border usually slightly notched, and its ventral border without notch. (52) Intermetacarpal tubercle extending to but not ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III obsolete. (54) With one strongly developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 51-53 per cent of length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only slightly produced beyond acetabular border as a minute point. (58) Depression on medial side of pectineal process obsolete, and without foramen. (59) Posterior iliac crest usually without prominence. (60) Ridge originating on posterior iliac crest at level of ilio-iliac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence weakly or sharply arising from its posterior portion; or pelvis without this ridge or prominence. (61) Dorsal face of post-acetabular ilium moderately broad anteriad, narrowing posteriad to form rounded or pointed apex of moderately or much elongated and narrow dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium obsolete, triangular, and horizontal in position, and forming ventral floor of posterior process. (63) Lateral face of post-acetabular ilium with its postero-dorsal apex acute, and forming moderately or much elongated lateral wall of posterior process. (64) Renal bar broad, with bar, but not posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse processes of fourth synsacral vertebra 71-79 per cent length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.--(67) Distal width 17-19 per cent of length. (68) Head moderately enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter depressed and deflected, with its dorsal border flat. (72) Trochanteric ridge 21-26 per cent length of femur (Table 5). (73) Distal depth 83-85 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.--(76) Depth of inner cnemial crest 58-68 per cent of its length (Table 4). (77) Outer cnemial crest straight. (78) Interarticular tubercle moderately or strongly produced. (79) Area between external articular surface and outer cnemial crest moderately or deeply concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge for proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge usually straight.

Tarsometatarsus.--(85) Distal width 17-18 per cent of length (Table 6) (86) Proximal depth 96-100 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex pointed. (88) Posterior intercotylar area moderately excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen usually very deeply excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and one or two closed calcaneal canals. (91) Anterior metatarsal groove reduced. (92) Depth of middle trochlea 54-57 per cent of distal width.

(93) Trochlea for digit II only slightly inflected. (94) Wing of trochlea for digit IV depressed anteroposteriorly, thus entire trochlea slightly longer than deep.

Intermembral proportions.--(95) Wing/leg 64-68 per cent (Table 2). (96) Ulna/humerus 96-102 per cent. (97) Tarsometatarsus/femur 84-87 per cent. (98) Tarsometatarsus/tibiotarsus 63-65 per cent. (99) Humerus/femur 82-86 per cent. (100) Humerus/tibiotarsus 61-64 per cent. (101) Ulna/femur 80-85 per cent. (102) Ulna/tibiotarsus 60-62 per cent. (103) Ulna/tarsometatarsus 92-99 per cent. (104) Carpometacarpus/femur 47-49 per cent. (105) Carpometacarpus/tibiotarsus 33-36 per cent. (106) Carpometacarpus/tarsometatarsus 51-58 per cent. (107) Tarsometatarsus/humerus 99-101 per cent. (108) Ilium/sternum 71-76 per cent. (109) Height of sternal carina/ilium 41-44 per cent.

Specific Variation in Odontophorus

Sternum.--(1) Height of carina through sternal plate 32-33 per cent length of sternum (29 per cent length of sternum in O. guttatus). (2) Dorsal lip of coracoidal sulcus projected well beyond ventral lip (projected only slightly beyond ventral lip in O. gujanensis).

Coracoid.--(3) Head moderately reflected (moderately inflected in O. guttatus). (4) Brachial tuberosity with moderate dorsal overhang (slight dorsal overhang in O. gujanensis). (5) Dorsal intermuscular line with distal three-fourths sharply raised (with distal two-thirds sharply raised in O. guttatus). (6) Dorsal face deeply excavated distally (moderately excavated distally in O. stellatus). (7) Distal border of sternal facet shallowly concave (deeply concave in O. guttatus).

Scapula.--(8) Glenoid facet oval in dorsal view (elliptical in O. guttatus). (9) Dorsal depression just mediad to glenoid facet moderately or deeply excavated (shallowly excavated in O. stellatus). (10) Acromion process with its apex only slighly deflected (moderately deflected in O. guttatus).

Humerus.--(11) Pneumatic fossa oval, and without inner shelf (elliptical, with a perforated inner shelf extending from external bicipital surface to medial bar in O. gujanensis). (12) Median crest strongly developed (very strongly developed in O. gujanensis). (13) External tuberosity slightly inflated in O. guttatus moderately inflated in O. stellatus, much inflated in O. gujanensis. (14) Deltoid crest moderately developed (strongly developed in O. gujanensis).

Ulna.--(15) External cotyla rounded throughout (flattened dorsally in O. guttatus), with its distal border sloping gently into shaft (sloping precipitously into shaft in O. guttatus), and only slightly notched by proximal radial impression (deeply notched by proximal radial impression in O. gujanensis). (16) Distal radial impression obsolete (moderately excavated in O. gujanensis).

Carpometacarpus.---(17) Ligamental attachment of pisiform process much swollen proximally (moderately swollen proximally in O. gujanensis).

Pelvis.---(18) Ridge originating on posterior iliac crest at level of ilio-ischiac fenestra, and continuing ventrad and posteriad towards posterior border of ilium with prominence sharply arising from its posterior portion in O. guttatus (prominence weakly arising in O. stellatus, sharply arising, or without ridge and prominence in O. gujanensis). (19) Dorsal face of post-acetabular ilium much elongated and narrow, and with its apex pointed (moderately elongated and narrow, with its apex rounded in O. stellatus). (20) Lateral face of post-acetabular ilium much elongated (moderately elongate in O. guttatus).

Tibiotarsus.---(21) Depth of inner cnemial crest 65-68 per cent of its length (58 per cent of its length in O. gujanensis). (22) Interarticular tubercle moderately produced (strongly produced in O. stellatus). (23) Area between external articular surface and outer cnemial crest deeply concave in dorsal view (moderately concave in O. gujanensis).

Tarsometatarsus.---(24) Hypotarsus with one closed calcaneal canal in O. stellatus (one or two in O. gujanensis, two in O. guttatus).

Intermembral proportions.---(25) Wing/leg 67-68 per cent (64 per cent in O. guttatus). (26) Carpometacarpus/humerus

57 per cent (54 per cent in *O. guttatus*). (27) Tarsometatarsus/tibiotarsus 63 per cent (65 per cent in *O. guttatus*). (28) Humerus/femur 84-86 per cent (82 per cent in *O. guttatus*). (29) Ulna/femur 83-85 per cent (80 per cent in *O. guttatus*). (30) Ulna/tarsometatarsus 98-99 per cent (92 per cent in *O. guttatus*). (31) Carpometacarpus/femur 47-49 per cent (45 per cent in *O. guttatus*). (32) Carpometacarpus/tibiotarsus 35-36 per cent (33 per cent in *O. guttatus*). (33) Carpometacarpus/tarsometatarsus 55-58 per cent (51 per cent in *O. guttatus*). (34) Ilium/sternum 74-76 per cent (71 per cent in *O. guttatus*).

Remarks.--As in skeletons of Recent *Lophortyx*, those of *Odontophorus* show more interspecific differences than do those of Recent species of *Colinus*. *Odontophorus guttatus* differs from *O. gujanensis* and *O. stellatus* in many intermembral ratios, and thus it has many more unique characters than these forms. *Odontophorus gujanensis* resembles *O. stellatus* in 19 of 33 characters. *O. guttatus* in three of 33 characters, and is unique in 11 of 33 characters. *Odontophorus stellatus* resembles *O. gujanensis* in 19 of 33 characters, *O. guttatus* in 10 of 33 characters, and is unique in four of 33 characters. *O. guttatus* resembles *O. stellatus* in 10 of 33 characters, *O. gujanensis* in three of 33 characters, and is unique in 20 of 33 characters.

According to the small available sample, the skeletons of *O. gujanensis* and *O. guttatus* are similar in size, and slightly larger than O. stellatus.

Dactylortyx Ovilvie-Grant 1893

The single species of this genus, Dactylortyx thoracicus (Gambel 1848) is confined to Mexico and northern Central America, mainly in the mountains.

Rostrum.--(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.--(3) Height of carina through sternal plate 31-34 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus even with or projecting only slightly beyond ventral lip. (5) Depressions on anterior part of sternal plate shallow or obsolete, and non-pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.--(7) Entire proximal end straight above procoracoid process. (8) Head narrowly rounded moderately compressed, and moderately inflected. (9) Brachial tuberosity with slight dorsal and ventral overhang. (10) Furcular facet moderately inflated. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft wide proximally with distal portion of its ventral surface concave medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal three-fourths sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoid process. (16) Dorsal face deeply excavated distally and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale usually obsolete and always irregular in shape. (18) Internal distal angle without distinct tubercle or ridge. (19) Sterno-coracoidal process with distal margin slightly oblique, not produced as a sharply raised ridge, and without dorsal groove, with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet deeply concave.

Scapula.--(21) Glenoid facet oval in dorsal view. (22) Dorsal depression just mediad to glenoid facet shallowly excavated. (23) Bridge between acromion process and glenoid facet about one-half width of glenoid facet. (24) Acromion process with its apex rounded, and with slight to moderate deflection.

Humerus.--(25) Pneumatic fossa a short to moderately long ellipse or ovaloid without inner shelf. (26) Median crest strongly developed, elevated only at its middle. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II much swollen, shortened, and with its apex rounded. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, pointed, and with its distal border lacking a groove. (35) Deltoid crest moderately developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle usually at level of internal condyle. (37) Entepicondylar prominence much produced, with its pit usually placed on internal face. (38) Depression of M. brachialis anticus shallowly excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.---(40) Olecranon process strongly produced, and with its apex truncated. (41) External cotyla moderately elongate, rounded throughout, with its distal border sloping gently into shaft, and only slightly notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 71 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle moderately produced, usually arising abruptly from shaft, and usually rounded throughout.

Carpometacarpus.---(47) Metacarpal I usually rounded terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process ovaloid in internal view, slightly reflected dorsad, thus below level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and much swollen proximally, flattened distally, with proximal portion connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border slightly notched, and its ventral border without notch. (52) Intermetacarpal tubercle extending to but not ankylosing with metacarpal III, and proximally placed with only a minute space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III obsolete. (54) With one moderately developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 55-58 per cent length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process absent, or obsolete and only slightly produced beyond acetabular border as a minute point. (58) Depression on medial side of pectineal process absent. (59) Posterior iliac crest with prominence moderately produced from just posterior to ilio-ischiac fenestra. (60) Without ridge or prominence ventral to posterior iliac crest. (61) Dorsal face of post-acetabular ilium moderately broadened anteriad, narrowing gently posteriad to form truncated apex of moderately long, narrow dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium obsolete, rectangular, and horizontal in position, and forming ventral floor of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex acute, and forming elongate lateral wall of posterior process. (64) Renal bar broad, with bar, but not posterior process excavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse process of fourth synsacral vertebra 88-93 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.---(67) Distal width 19 per cent of length (Table 5). (68) Head much enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter compressed and reflected, with its dorsal border rounded. (72) Trochanteric ridge 15-18 per cent length of femur. (73) Distal depth 81-84 per cent of distal width. (74) Internal condyle narrow, and with its anterior border usually weakly produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.---(76) Depth of inner cnemial crest 42-48 per cent of its length (Table 4). (77) Outer cnemial crest straight. (78) Interarticular tubercle weakly produced. (79) Area between external articular surface and outer cnemial crest very deeply concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge for proximal internal ligamental attachment without deeply excavated depression. (82) Area of internal ligamental attachment on internal condyle not produced as a prominence. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border supratendinal bridge straight.

Tarsometatarsus.--(85) Distal width 19-21 per cent of length (Table 6). (86) Proximal depth 88-94 per cent of proximal width. (87) Intercotylar prominence only slightly deflected, and with its apex usually pointed. (88) Posterior intercotylar area moderately excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen moderately excavated. (90) Hypotarsus with two well developed and one weakly developed calcaneal ridges, two calcaneal grooves, and two closed calcaneal canals. (91) Anterior metatarsal groove reduced or obsolete. (92) Depth of middle trochlea 45-50 per cent of distal width. (93) Trochlea for digit II moderately inflected. (94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.--(95) Wing/leg 72-73 per cent (Table 2). (96) Ulna/humerus 98-100 per cent. (97) Tarsometatarsus/femur 81-82 per cent. (98) Tarsometatarsus/tibiotarsus 59-60 per cent. (99) Humerus/femur 90-91 per cent. (100) Humerus/tibiotarsus 66-67 per cent. (101) Ulna/femur 88-91 per cent. (102) Ulna/tibiotarsus 65-66 per cent. (103) Ulna/tarsometatarsus 109-111 per cent. (104) Carpometacarpus/femur 48-50 per cent. (105) Carpometacarpus/tibiotarsus 35-36 per cent. (106) Carpometacarpus/tarsometatarsus 59-62 per cent. (107) Tarsometatarsus/humerus 90 per cent. (108) Ilium/sternum 70-78 per cent. (109) Height of sternal carina/ilium 40-49 per cent.

Cyrtonyx Gould 1844

The genus Cyrtonyx is confined to the mountains of the southwestern United States, Mexico, and northern Central America. Three species are recognized, of which C. montezumae (Vigors 1830) was examined.

Rostrum.--(1) Relatively long and shallow. (2) Nasal fossae elliptical.

Sternum.--(3) Height of carina through sternal plate 28-32 per cent length of sternum (Table 3). (4) Dorsal lip of coracoidal sulcus usually projected well beyond ventral lip. (5) Depressions on anterior part of sternal plate shallow and non-pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.--(7) Entire proximal end straight above procoracoid process. (8) Head narrowly rounded, moderately compressed, and moderately inflected. (9) Brachial tuberosity with slight dorsal and ventral overhang. (10) Furcular facet obsolete. (11) Bicipital attachment well developed, with margin between it and head concave. (12) Shaft wide proximally, with distal portion of its ventral surface usually convex medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sterno-coracoid process. (16) Dorsal face deeply excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale usually well developed and rounded. (18) Internal distal angle without distinct tubercle or ridge on dorsal face. (19) Sterno-coracoidal process with distal margin slightly oblique, not produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet deeply concave.

Scapula.---(21) Glenoid facet oval in dorsal view. (22) Dorsal depression just mediad to glenoid facet obsolete to shallowly excavated. (23) Bridge between acromion process and glenoid facet about one-half width of glenoid facet. (24) Acromion process with its apex rounded, and very strongly deflected.

Humerus.---(25) Pneumatic fossa a moderately long ellipse or ovaloid, without inner shelf. (26) Median crest strongly developed, elevated only at its middle. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II moderately swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising gently from shaft, pointed, and with its distal border lacking a groove. (35) Deltoid crest moderately developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle produced slightly beyond level of internal condyle. (37) Entepicondylar prominence moderately produced with its pit placed on palmar face. (38) Depression of M. brachialis anticus shallowly excavated. (39) Distal border of external condyle rounded in anconal view.

Ulna.--(40) Olecranon process strongly produced, with its apex pointed. (41) External cotyla moderately elongate, rounded throughout, with its distal border sloping gently into shaft, and only slightly notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 60-63 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle moderately produced, usually arising abruptly from shaft, and usually rounded throughout.

Carpometacarpus.--(47) Metacarpal I usually moderately pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process oval or ovaloid in internal view, slightly reflected dorsad, thus usually below, occasionally at level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform process produced and moderately swollen proximally, flattened distally, with proximal portion connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border shallowly concave, and its ventral border without notch. (52) Intermetacarpal tubercle not reaching or barely extending to metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III elongate and moderately produced. (54) With one obsolete to weakly developed tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 50-54 per cent length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only slightly produced beyond acetabular border as a minute point. (58) Depression on medial side of pectineal process obsolete, and without foramen. (59) Posterior iliac crest with prominence strongly produced from just posterior to ilio-ischiac fenestra. (60) Without ridge or prominence ventral to posterior iliac crest. (61) Dorsal face of post-acetabular ilium narrow anteriad, further narrowing gently posteriad to form pointed apex of much elongated, narrow, dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium, obsolete, narrowly triangular, horizontal in position, and forming ventral floor of posterior process. (63) Lateral face of post-acetabular ilium with its postero-dorsal apex much pointed, and forming much elongated lateral wall of posterior process. (64) Renal bar broad, with bar, but not posterior process excavated by renal depression. (65) Ischium at angle of about 145 degrees to ventral edge of posterior iliac crest. (66) Width through transverse processes of fourth synsacral vertebra 67-71 per cent of length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.--(67) Distal width 17-19 per cent of length (Table 5). (68) Head moderately enlarged, neither bent dorsally nor rotated posteriorly. (69) Neck short. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter depressed and deflected, with its dorsal border flat. (72) Trochanterid ridge 23-25 per cent length of femur. (73) Distal depth

75-79 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border usually weakly produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.---(76) Depth of inner cnemial crest 37-46 per cent of its length. (77) Outer cnemial crest usually straight. (78) Interarticular tubercle weakly produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge for proximal internal ligamental attachment without deeply excavated depression. (82) Internal ligamental prominence on internal condyle moderately produced. (83) Face of internal condyle moderately excavated, with its border moderately elevated. (84) Dorsal border of supratendinal bridge straight.

Tarsometatarsus.---(85) Distal width 21-22 per cent of length (Table 6). (86) Proximal depth 95-98 per cent of proximal width. (87) Intercotylar prominence moderately deflected, and with its apex pointed. (88) Posterior intercotylar area usually moderately excavated as a triangular depression. (89) Area surrounding posterior opening of inner proximal foramen moderately excavated. (90) Hypotarsus with two well developed and one obsolete calcaneal ridges, two calcaneal grooves, and two closed calcaneal canals.

(91) Anterior face of shaft usually moderately excavated by anterior metatarsal groove. (92) Depth of middle trochlea 46-58 per cent of distal width. (93) Trochlea for digit II moderately inflected. (94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.---(95) Wing/leg 78-81 per cent (Table 2). (96) Ulna/humerus 93-94 per cent. (97) Tarsometatarsus/femur 70-73 per cent. (98) Tarsometatarsus/tibiotarsus 53-56 per cent. (99) Humerus/femur 95-101 per cent. (100) Humerus/tibiotarsus 72-75 per cent. (101) Ulna/femur 88-93 per cent. (102) Ulna/tibiotarsus 68-71 per cent. (103) Ulna/tarsometatarsus 126-133 per cent. (104) Carpometacarpus/femur 50-52 per cent. (105) Carpometacarpus/tibiotarsus 38-40 per cent. (106) Carpometacarpus/tarsometatarsus 71-74 per cent. (107) Tarsometatarsus/humerus 70-74 per cent. (108) Ilium/sternum 72-76 per cent. (109) Height of sternal carina/ilium 38-41 per cent.

Rhynchortyx Ogilvie-Grant 1893

The monotypic genus Rhynchortyx occurs in the tropical lowlands from Honduras to Ecuador. Measurements of R. cinctus (Salvin 1876) are given in Table 7.

Rostrum.---(1) Short and deep. (2) Nasal fossae round.

Sternum.---(3) Height of carina through sternal plate 35 per cent length of sternum. (4) Dorsal lip of coracoidal sulcus projected only slightly beyond ventral lip. Depressions on anterior portion of sternal plate deep and very pneumatic. (6) Base of posterior lateral process less than one-half width of sternal plate at its middle.

Coracoid.---(7) Entire proximal end straight above procoracoid process. (8) Head broadly rounded, much depressed, and moderately inflected. (9) Brachial tuberosity with slight dorsal, and obsolete ventral overhang. (10) Furcular facet obsolete. (11) Bicipital attachment weakly developed, with margin between it and head straight. (12) Shaft wide proximally, with distal portion of its ventral surface convex medially. (13) Procoracoid process with its apex rounded. (14) Dorsal intermuscular line swinging out to medial surface of shaft, with distal half sharply raised. (15) Ventral intermuscular line terminating at tip of sternocoracoid process. (16) Dorsal face weakly excavated distally, and without fossa. (17) Tubercle for ligamentum sterno-coracoideum dorsale obsolete, and irregular in shape. (18) Internal distal angle with distinct, but weakly developed dorsal ridge extending obliquely to above lateral end of sternal facet. (19) Sterno-coracoidal process with distal margin moderately oblique, produced as a sharply raised ridge, and without dorsal groove; with its tip directed laterally, and ending in a terminal knob. (20) Distal border of sternal facet deeply concave.

Scapula.---(21) Glenoid facet oval in dorsal view.

(22) Dorsal depression just mediad to glenoid facet obsolete. (23) Bridge between acromion process and glenoid facet more than one-half width of glenoid facet. (24) Acromion process with its apex truncated, and very slightly deflected.

Humerus.---(25) Pneumatic fossa a moderately long ellipse, without inner shelf. (26) Median crest strongly developed, elevated only at its middle. (27) Capital groove moderately excavated, with its internal margin moderately elevated. (28) Margin between head and internal tuberosity, moderately concave. (29) Head broader than long in anconal view. (30) Ridge along medial border of fossa II moderately swollen, elongate, and with its apex acute. (31) Fossa II well developed. (32) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (33) External tuberosity moderately inflated. (34) Bicipital crest arising abruptly from shaft, rounded, and with shallow groove in its distal margin. (35) Deltoid crest moderately developed, slightly inflected, and with its summit knob-like. (36) Entepicondyle at level of internal condyle. (37) Entepicondylar prominence much produced, with its pit placed on palmar face. (38) Scar for M. brachialis anticus without excavation. (39) Distal border of external condyle rounded in anconal view.

Ulna.---(40) Olecranon process weakly produced, with its apex rounded. (41) External cotyla moderately elongate, rounded throughout with its distal border sloping gently into shaft, and deeply notched by proximal radial impression. (42) Impression for M. brachialis anticus excavated, with its borders distinct. (43) Height at middle of shaft 61 per cent of height just distal to external cotyla (Table 4). (44) Distal radial impression obsolete. (45) Notch between carpal tuberosity and internal condyle well developed. (46) External condyle weakly produced, arising very gently from shaft, and rounded throughout.

Carpometacarpus.--(47) Metacarpal I moderately pointed terminally. (48) Ridge separating anterior carpal fossa from excavated area above pisiform process produced, and extends well onto base of metacarpal I. (49) Pisiform process elliptical in internal view, slightly reflected dorsad, thus below level of dorsal rim of inner carpal trochlea. (50) Ligamental attachment of pisiform weakly produced and only slightly swollen proximally, flattened distally, with proximal portion connected to pisiform process by bony bridge. (51) Internal carpal trochlea with its proximal border shallowly concave and its ventral border without notch. (52) Intermetacarpal tubercle extending to but not ankylosing with metacarpal III, and distally placed with a small space between its posterior border and junction of metacarpals II and III. (53) Tubercle on internal proximal face of metacarpal III elongate and moderately produced. (54) With one obsolete tubercle on external proximal face of metacarpal III. (55) Metacarpal III slightly bowed.

Pelvis.--(56) Width of pelvis through antitrochanters 59 per cent length of innominate from anterior edge of ilium to ischial angle (Table 3). (57) Pectineal process obsolete, only slightly produced beyond acetabular border as a minute point. (58) Depression on medial side of pectineal process obsolete, and without foramen. (59) Posterior iliac crest with prominence weakly produced from just posterior to ilio-ischiac fenestra. (60) Without ridge or prominence ventral to posterior iliac crest. (61) Dorsal face of post-acetabular ilium moderately broadened anteriad, narrowing gently posteriad to form truncated apex of moderately long, narrow dorsal roof of posterior process. (62) Caudal face of post-acetabular ilium obsolete, rectangular, and horizontal in position, and forming ventral floor of posterior process. (63) Lateral face of post-acetabular ilium with its posterodorsal apex truncated, and forming moderately elongate lateral wall of posterior process. (64) Renal bar broad, with bar slightly excavated, but posterior process unexcavated by renal depression. (65) Ischium at angle of about 160 degrees to ventral edge of posterior iliac crest. (66) Width through transverse processes of fourth synsacral vertebra 92 per cent length of synsacrum from centrum of first synsacral vertebra through transverse process of fourth synsacral vertebra.

Femur.---(67) Distal width 18 per cent of length (Table 5). (68) Head moderately enlarged, bent dorsally, but without posterior rotation. (69) Neck only moderately long. (70) Iliac facet without compression, with posterior border convex. (71) Dorsal crest of trochanter obsolete, with its dorsal border flat. (72) Trochanteric ridge 12 per cent length of femur. (73) Distal depth 71 per cent of distal width. (74) Internal condyle moderately wide, and with its anterior border much produced throughout. (75) External condyle compressed, and rounded anteriorly.

Tibiotarsus.---(76) Depth of inner cnemial crest 75 per cent of its length (Table 4). (77) Outer cnemial crest decurved. (78) Interarticular tubercle moderately produced. (79) Area between external articular surface and outer cnemial crest moderately concave in dorsal view. (80) Posterior margin between external and internal articular surface with a distinct notch. (81) Area just anterior to ridge for proximal internal ligamental attachment without deeply excavated depression. (82) Area of internal ligamental attachment on internal condyle not produced as a prominence. (83) Face of internal condyle weakly excavated, with its border weakly elevated. (84) Dorsal border of supratendinal bridge oblique.

Tarsometatarsus.---(85) Distal width 16 per cent of length (Table 6). (86) Proximal depth 95 per cent of proximal width. (87) Intercotylar prominence depressed,

without deflection, and with its apex broadly rounded. (88) Posterior intercotylar area unexcavated. (89) Area surrounding posterior opening of inner proximal foramen shallowly excavated. (90) Hypotarsus with three well developed calcaneal ridges, two calcaneal grooves, and one closed calcaneal canal. (91) Anterior face of shaft extensively excavated by anterior metatarsal groove.
(92) Depth of middle trochlea 56 per cent of distal width.
(93) Trochlea for digit II only slightly inflected.
(94) Wing of trochlea for digit IV depressed dorsoventrally, thus entire trochlea much deeper than long.

Intermembral proportions.---(95) Wing/leg 67 per cent (Table 2). (96) Ulna/humerus 98 per cent. (97) Tarsometatarsus/femur 88 per cent. (98) Tarsometatarsus/tibiotarsus 63 per cent. (99) Humerus/femur 85 per cent. (100) Humerus/tibiotarsus 61 per cent. (101) Ulna/femur 87 per cent. (102) Ulna/tibiotarsus 62 per cent. (103) Ulna/tarsometatarsus 99 per cent. (104) Carpometacarpus/femur 48 per cent. (105) Carpometacarpus/tibiotarsus 34 per cent. (106) Carpometacarpus/tarsometatarsus 55 per cent. (107) Tarsometatarsus/humerus 103 per cent. (108) Ilium/sternum 68 per cent. (109) Height of sternal carina/ilium 52 per cent.

Summary of Generic Characters

Important osteological characters of the New World quail include the four classes. (1) Characters of the pelvis that tend to divide the New World quail into two major groups. An example of one of these characters is the poorly developed, slender, renal bar in *Dendrortyx*, *Philortyx*, *Oreortyx*, *Callipepla*, *Colinus*, and *Lophortyx*, and the well developed, broad renal bar in *Odontophorus*, *Dactylortyx*, *Cyrtonyx*, and *Rhynchortyx*. (2) Primitive characters that are apparently hold-overs from less highly evolved groups. An example is the indistinct fossa II of the humerus as found in *Dendrortyx* and *Odontophorus*. (3) Characters that are unique in certain genera. An example is the short, deep rostrum, with round nasal fossae, as found in *Rhynchortyx*. (4) Characters that are not unique, but may be used in combination with other such characters for generic definition.

When a character does not hold absolutely in the genus, but occurs in most individuals of the genus, the condition is modified by the word "usually." Characters that hold in some genera, but vary specifically or show much individual variation in other genera are listed as "variable." Characters that show much individual variation in all genera, and ratios that would probably overlap in greater series, are omitted from the following section.

Rostrum.--The rostrum is relatively long and shallow, and the nasal fossae are elliptical in most New World quail. In *Rhynchortyx* the rostrum is much shorter and deeper, and its nasal fossae are round.

Sternum.--The dorsal lip of the coracoidal sulcus projects well beyond the ventral lip in most genera. In Dactylortyx the dorsal lip projects only slightly beyond the ventral lip, and in Rhynchortyx the dorsal lip lies even with or projected only slightly beyond the ventral lip. The character is variable in Cyrtonyx and Odontophorus.

The depressions on the anterior portion of the sternal plate are deep and very pneumatic in Rhynchortyx, deep and moderately pneumatic in Oreortyx, deep and slighly pneumatic in Philortyx, shallow and slightly pneumatic in Dendrortyx, usually shallow and non-pneumatic in Colinus, shallow and non-pneumatic in Cyrtonyx, shallow or obsolete and non-pneumatic in Dactylortyx, obsolete and non-pneumatic in Odontophorus, and variable in Callipepla and Lophortyx.

The base of the posterior lateral process is narrow and less than one-half the width of the sternal plate at its middle in most genera, but it is wide, and more than one-half the width of the sternal plate at its middle in Dendrortyx.

Coracoid.--The entire proximal end is straight above the level of the procoracoid process in most New World quail, but it is bent ventrad above the level of the procoracoid process in Dendrortyx.

The head is narrowly rounded and moderately compressed in most genera, but it is pointed and much compressed in *Philortyx*, broadly rounded and much depressed in *Dendrortyx* and *Rhynchortyx*, and broadly rounded and moderately depressed in *Oreortyx*.

The head is moderately inflected in *Callipepla*, *Lophortyx*, *Dactylortyx*, *Cyrtonyx*, and *Rhynchortyx*, and much inflected in *Dendrortyx*, but it is moderately reflected in *Oreortyx*, much reflected in *Philortyx*, and variable in *Colinus* and *Odontophorus*.

The brachial tuberosity has a slight dorsal and ventral overhang in most New World quail, but it has a moderate dorsal and slight ventral overhang in *Dendrortyx*, a slight dorsal and obsolete ventral overhang in *Rhynchortyx*, an obsolete dorsal and slight ventral overhang in *Philortyx*, and is variable in *Odontophorus*.

The furcular facet is obsolete in *Rhynchortyx* and *Cyrtonyx*, weakly inflated in *Dendrortyx*, *Philortyx*, and *Lophortyx*, moderately inflated in *Oreortyx*, *Callipepla*, and *Dactylortyx*, much inflated in *Odontophorus*, and variable in *Colinus*.

The bicipital attachment is well developed, with the margin between it and the head concave in most genera, but in *Rhynchortyx* it is weakly developed and with the margin between it and the head straight.

The procoracoid process has its apex rounded in most New World quail, but it is acute in *Philortyx* and

Callipepla, and it is variable in Colinus.

The dorsal intermuscular line swings out to the medial surface of the shaft in most genera, but the line swings out to the lateral border of the shaft in Dendrortyx. The distal half of the dorsal intermuscular line is sharply raised in most forms, but the sharply raised portion is confined to the distal three-fourths in Dactylortyx, the distal two-thirds or three-fourths in Odontophorus, and only the distal one-fifth in Dendrortyx.

The ventral intermuscular line terminates at the tip of the sterno-coracoidal process in most genera. It terminates in the middle of the distal border of the sterno-coracoidal process in Dendrortyx.

The dorsal face is weakly excavated distally in Dendrortyx, Philortyx, Oreortyx, Callipepla, and Rhynchortyx, moderately excavated distally in Colinus, deeply excavated distally in Cyrtonyx and Dactylortyx, and variable in Lophortyx and Odontophorus. The dorsal face lacks a distinct fossa in most genera, but has a distinct, round deep fossa below the tubercle for the ligamentum sterno-coracoideum dorsale, and above the external end of the sternal facet in Dendrortyx.

The tubercle for the ligamentum sterno-coracoideum dorsale is obsolete and irregular in shape in Rhynchortyx and Odontophorus, obsolete and rounded in Dendrortyx and Callipepla, well developed but irregular in shape in

Oreortyx, well developed and rounded in Philortyx, and variable in the other genera.

The internal distal angle is without a distinct tubercle or ridge in most New World quail. It has a distinct but irregular tubercle that extends obliquely to above the lateral end of the sternal facet in Oreortyx and Callipepla. In Philortyx and Rhynchortyx it has a distinct oblique ridge, with this structure weakly developed in the latter genus.

The sterno-coracoidal process has its distal margin slightly oblique, neither produced as a sharply raised ridge, nor grooved dorsally, and its tip is directed laterally and possesses a terminal knob in most New World quail. Philortyx differs in that the distal margin of the sterno-coracoidal process is moderately oblique, Rhynchortyx in that the distal margin is moderately oblique, and produced as a sharply raised ridge, and Dendrortyx in that the distal margin is strongly oblique, grooved dorsally, with the tip of the sterno-coracoidal process directed proximally and without a terminal knob.

The distal border of the sternal facet is deeply concave in Oreortyx, Rhynchortyx, and Dactylortyx, usually deeply concave in Colinus, shallowly concave in Philortyx, very shallowly concave in Dendrortyx, and variable in the other genera.

Scapula.--The glenoid facet is oval in dorsal view in most New World quail, but is elliptical in dorsal view in *Dendrortyx*, and variable in *Odontophorus*.

The bridge between the acromion process and glenoid facet is about one-half the width of the glenoid facet in most genera, but the bridge is about one-third the width of the glenoid facet in *Philortyx*, and variable in *Colinus*, *Lophortyx*, and *Odontophorus*.

The acromion process has its apex rounded in most New World quail, but it is acute in *Dendrortyx* and *Oreortyx* and truncated in *Rhynchortyx*. The amount of deflection of the acromion process shows much variation within a genus, but it is much more strongly deflected in *Cyrtonyx* than in the other forms.

The shape of the pneumatic fossa shows much variation within genera of New World quail, but only one form, a species of *Odontophorus*, has a perforated inner shelf that extends from the external bicipital surface to the medial bar.

The median crest is strongly or very strongly developed in *Odontophorus*, strongly developed in *Dendrortyx*, *Oreortyx*, *Cyrtonyx*, *Rhynchortyx*, and *Dactylortyx*, moderately to strongly developed in *Colinus*, usually weakly developed in *Callipepla*, weakly developed in *Philortyx*, and variable in *Lophortyx*. The median crest is elevated only at its middle in most genera, but is elevated throughout in *Dendrortyx*, *Philortyx*, and *Odontophorus*, and variable in *Lophortyx*.

The capital groove is moderately excavated and its internal margin is moderately elevated in most New World quail, but it is deeply excavated with its internal margin strongly elevated in *Dendrortyx* and *Philortyx*.

The margin between the head and internal tuberosity is moderately concave in most genera but is only slightly concave in *Dendrortyx*.

The head is broader than long in most New World quail, but it is about as long as broad in *Dendrortyx* and *Philortyx*, and is variable in *Lophortyx*.

The ridge along the medial border of fossa II is moderately swollen in *Callipepla*, *Lophortyx*, *Odontophorus*, *Cyrtonyx*, and *Rhynchortyx*, slightly to moderately swollen in *Colinus*, slightly swollen in *Dendrortyx* and *Philortyx*, and much swollen in *Oreortyx* and *Dactylortyx*. The ridge along the medial border of fossa II is elongate and pointed in most genera, but it is short and rounded in *Dactylortyx*.

Fossa II is well developed in most forms but is obsolete in *Dendrortyx* and *Odontophorus*.

The latissimus ridge originates on the lateral edge of the shaft and swings onto the anconal face proximally in most New World quail, but the ridge extends along the lateral edge of the shaft throughout its length in *Dendrortyx*.

The external tuberosity is moderately inflated in most forms, but it is much inflated in *Oreortyx*, and variable in *Odontophorus*.

The bicipital crest arises gently from the shaft in most New World quail but arises abruptly from the shaft in *Rhynchortyx*. The bicipital crest is pointed in *Philortyx*, *Oreortyx*, *Cyrtonyx*, and *Dactylortyx*, usually narrowly rounded in *Colinus*, narrowly rounded in *Callipepla* and *Lophortyx*, and rounded in *Dendrortyx*, *Rhynchortyx*, and *Odontophorus*. The bicipital crest lacks a groove in its distal margin in most forms, but has a shallow groove in *Rhynchortyx*.

The deltoid crest is moderately developed in most forms, but it is much developed in *Dendrortyx*, and variable in *Odontophorus*. The deltoid crest is slightly inflected in most forms but is much inflected in *Dendrortyx*. The summit of the deltoid crest is knob-like in most New World quail, but it is usually flattened in *Lophortyx*, and variable in *Colinus*.

The entepicondyle is at the level of the internal condyle in *Dendrortyx*, *Oreortyx*, *Callipepla*, and *Rhynchortyx*, usually at the level of the internal condyle in *Colinus* and *Dactylortyx*, and produced slightly beyond the internal condyle in *Philortyx*, *Lophortyx*, *Odontophorus*, and *Cyrtonyx*.

The entepicondylar prominence is weakly produced in *Dendrortyx*, moderately produced in *Philortyx*, *Oreortyx*, *Callipepla*, *Colinus*, *Lophortyx*, and *Cyrtonyx*, and much produced in *Odontophorus*, *Dactylortyx*, and *Rhynchortyx*. The pit of the entepicondylar prominence is placed on the internal face of the humerus in most forms, but it is placed on the palmar face in *Callipepla*, *Cyrtonyx*, and *Rhynchortyx*.

The depression for the M. brachialis anticus is deeply excavated in *Dendrortyx* and *Philortyx*, usually moderately excavated in *Colinus*, moderately excavated in *Lophortyx* and *Odontophorus*, usually shallowly excavated in *Callipepla*, shallowly excavated in *Oreortyx*, *Cyrtonyx*, and *Dactylortyx*, and represented by an unexcavated scar in *Rhynchortyx*.

The distal border of the external condyle is rounded in anconal view in most New World quail, but it is flat in anconal view in *Dendrortyx*.

Ulna.--The olecranon process is strongly produced in most New World quail but weakly produced in *Rhynchortyx*. The apex of the olecranon process is pointed in most forms, but it is rounded in *Dendrortyx* and *Rhynchortyx*, and truncated in *Dactylortyx*.

The external cotyla is moderately elongate in most genera, but it is much elongated in *Oreortyx*, and shortened in *Dendrortyx*. The external cotyla is rounded throughout, and its distal border slopes gently into the shaft in most forms, but it is flattened dorsally with its distal border sloping precipitously into the shaft in *Dendrortyx*, and it is variable in *Odontophorus*. The external cotyla is slightly notched by the proximal radial impression in *Oreortyx*, *Callipepla*, *Colinus*, *Cyrtonyx*, and *Dactylortyx*, usually slightly notched in *Colinus*, deeply notched in

Dendrortyx, Philortyx, and Rhynchortyx, and is variable in Odontophorus.

The impression for the M. brachialis anticus is excavated with its borders distinct in most New World quail, but it is represented by an unexcavated scar with indistinct borders in Philortyx.

The height at the middle of the shaft in most New World quail ranges from 60-72 per cent of the height of the shaft just distal to the external cotyla, with much overlap of ranges between genera. This ratio is 83 per cent in Dendrortyx and 85 per cent in Philortyx.

The distal radial impression is obsolete in most genera, well excavated in Dendrortyx, and variable in Odontophorus.

The notch between the carpal tuberosity and internal condyle is well developed in most forms, but it is obsolete in Dendrortyx.

The external condyle is well produced in Philortyx, Callipepla, Colinus, Lophortyx, and Odontophorus, moderately produced in Oreortyx, Cyrtonyx, and Dactylortyx, and weakly produced in Dendrortyx and Rhynchortyx. The external condyle arises abruptly from the shaft in most forms, usually arises abruptly from the shaft in Cyrtonyx, but arises gently from the shaft in Oreortyx, Lophortyx, and Rhynchortyx. The external condyle is rounded throughout in most genera, usually rounded in Cyrtonyx and Dactylortyx, but has its ventral border flattened in Dendrortyx and

Philortyx.

Carpometacarpus.--Metacarpal I is moderately pointed terminally in Dendrortyx, Philortyx, Callipepla, Odontophorus, and Rhynchortyx, usually moderately pointed terminally in Cyrtonyx, sharply pointed terminally in Oreortyx, usually rounded terminally in Dactylortyx, and variable in Colinus and Lophortyx.

The ridge that separates the anterior carpal fossa from the excavated area above the pisiform process is produced and extends well onto the base of the metacarpal I in most New World quail, but it is very weak and extends only slightly onto the base of the metacarpal I in Dendrortyx.

The pisiform process is ovaloid in internal view in Oreortyx, Lophortyx, Dactylortyx, and Odontophorus, elliptical in Rhynchortyx, round in Dendrortyx and Philortyx, and variable in Callipepla, Colinus, and Cyrtonyx. The pisiform process is slightly reflected dorsad and thus is below the level of the dorsal rim of the inner carpal trochlea in Oreortyx, Rhynchortyx, Dactylortyx, and Odontophorus, slightly reflected dorsad and usually below, but occasionally at the level of the inner carpal trochlea in Callipepla, Colinus, and Cyrtonyx, moderately reflected dorsad and thus produced slightly above the dorsal rim of the inner carpal trochlea in Philortyx, much reflected dorsad and produced well above the dorsal rim of the inner carpal trochlea in *Dendrortyx*, and variable in *Lophortyx*.

The ligamental attachment of the pisiform process is produced and much swollen proximally and flattened distally in most New World quail. *Odontophorus* differs in that the ligamental attachment is moderately or much swollen proximally, *Cyrtonyx* in that it is moderately swollen proximally, and *Rhynchortyx* in that it is weakly produced and only slightly swollen proximally, and *Dendrortyx* in that the ligamental attachment of the pisiform process is produced throughout and moderately swollen proximally and distally. The proximal portion of the ligamental attachment of the pisiform process is connected to the pisiform process by a bony bridge in most genera; the attachment is usually connected by a bony bridge in *Colinus*, separated from the pisiform process by a shallow sulcus in *Dendrortyx*, and variable in *Odontophorus*.

The proximal border of the internal carpal trochlea is shallowly concave in *Dendrortyx*, *Philortyx*, *Rhynchortyx*, *Cyrtonyx*, and *Dactylortyx*, distinctly concave in *Oreortyx*, usually slightly notched in *Lophortyx* and *Odontophorus*, deeply notched in *Callipepla*, and variable in *Colinus*. The ventral border of the internal carpal trochlea is without a notch in most genera, but it has a slight notch in *Dendrortyx* and *Oreortyx*.

The intermetacarpal tubercle extends to or slightly beyond metacarpal III without ankylosis with it in most New

World quail, it extends to and sometimes ankyloses with metacarpal III in Lophortyx, extends to and ankyloses with metacarpal III in Dendrortyx, and does not reach or barely extends to metacarpal III in Cyrtonyx. The intermetacarpal tubercle is relatively distally placed and has a small space between its posterior border and junction of metacarpals II and III in most genera, but it is more proximally placed and with only a minute space between its posterior border and junction of metacarpals II and III in Dactylortyx.

The tubercle on the internal proximal surface of the metacarpal III is obsolete in most forms, but it is elongate and weakly produced in Philortyx, and elongate and moderately produced in Oreortyx, Cyrtonyx, and Rhynchortyx.

The external proximal face of metacarpal III has a single strongly developed tubercle in Oreortyx, Callipepla, Colinus, Lophortyx, and Odontophorus, a single moderately developed tubercle in Philortyx and Dactylortyx, a single obsolete to weakly developed tubercle in Cyrtonyx, a single obsolete tubercle in Rhynchortyx, and one moderately developed and one obsolete tubercle in Dendrortyx.

Metacarpal III is slightly bowed in most New World quail but is moderately bowed in Dendrortyx.

Pelvis.--The pelvis of Dendrortyx, Philortyx, and Colinus is relatively narrow, and the ratio of the width of the pelvis through the antitrochanters divided by the length of the innominate from the anterior edge of the ilium to the ischial angle ranges from 44-51 per cent. The pelvis of Oreortyx, Callipepla, and Rhynchortyx is relatively wide, the ratio being 59 per cent in Rhynchortyx, 58-62 per cent in Callipepla, and 60-63 per cent in Oreortyx. The remaining genera are poorly separable on this character.

The pectineal process is moderately produced beyond the acetabular border with its apex pointed in Philortyx, Oreortyx, Callipepla, and Lophortyx, usually pointed in Colinus, but rounded in Dendrortyx. The pectineal process is only slightly produced beyond the acetabular border as a minute point in Odontophorus, Cyrtonyx, and Rhynchortyx, and in Dactylortyx it is usually absent or at most, represented by a minute point.

The depression on the medial side of the pectineal process is deeply excavated and perforated by a foramen in Dendrortyx, deeply excavated and without a foramen in Philortyx, and shallowly excavated and without a foramen in Oreortyx, Callipepla, Colinus, and Lophortyx. The depression on the medial side of the pectineal process is obsolete and without a foramen in Odontophorus, Cyrtonyx, and Rhynchortyx, and absent in Dactylortyx.

The posterior iliac crest lacks a prominence in most genera. A prominence is produced from the posterior iliac crest just posterior to the ilio-ischiac fenestra in Dactylortyx and Rhynchortyx. The prominence is weak in

Rhynchortyx, moderately produced in *Dactylortyx*, and strongly produced in *Cyrtonyx*.

A ridge originates on the posterior iliac crest at the level of the ilio-ischiac fenestra, continues ventrad and posteriad towards the posterior border of the ilium, and has a prominence arising from its posterior portion in most New World quail. The prominence arises sharply in *Dendrortyx*, *Philortyx*, *Lophortyx*, and *Colinus*, but it is weak in *Oreortyx* and *Callipepla*. The ridge and prominence are absent in *Dactylortyx*, *Cyrtonyx*, and *Rhynchortyx*. *Odontophorus* is variable in this character.

The dorsal face of the post-acetabular ilium is moderately broad anteriad and narrows abruptly posteriad to form the acute apex of the short, broad, dorsal roof of the posterior process in *Dendrortyx*, *Philortyx*, *Callipepla*, *Colinus*, and *Lophortyx*. It is much broadened anteriad, and narrows abruptly posteriad to form the acute apex of the very short broad dorsal roof of the posterior process in *Oreortyx*. In *Dactylortyx* and *Rhynchortyx* the dorsal face of the post-acetabular ilium is moderately broadened anteriad and narrows abruptly posteriad to form the truncated apex of the moderately long, narrow, dorsal roof of the posterior process. *Cyrtonyx* has the dorsal face of the post-acetabular ilium narrow anteriad, and it gradually further narrows posteriad to form the pointed apex of the much elongated, narrow, dorsal roof of the posterior process. *Odontophorus* is variable in this character.

The caudal face of the post-acetabular ilium is enlarged, triangular, and vertical in position, and its posterodorsal apex forms the posteromedial wall of the posterior process in *Dendrortyx*, *Philortyx*, *Callipepla*, *Colinus*, and *Lophortyx*. *Oreortyx* differs only in that the caudal face is broadly triangular. The caudal face of the post-acetabular ilium is obsolete, horizontal in position, and forms the ventral floor of the posterior process in *Odontophorus*, *Dactylortyx*, *Cyrtonyx*, and *Rhynchortyx*. It is rectangular in shape in *Dactylortyx* and *Rhynchortyx*, triangular in *Odontophorus*, and narrowly triangular in *Cyrtonyx*.

The lateral face of the post-acetabular ilium has an acute posterodorsal apex in most New World quail, but it is much pointed in *Cyrtonyx*, and truncated in *Rhynchortyx*. It forms the shortened lateral wall of the posterior process in most genera, but is moderately elongate in *Rhynchortyx*, elongate in *Dactylortyx*, moderately to much elongated in *Odontophorus*, and much elongated in *Cyrtonyx*.

The renal bar is very slender, and both the bar and the posterior process are excavated by the renal depression in *Dendrortyx*, *Callipepla*, *Colinus*, and *Lophortyx*. It is moderately slender in *Philortyx*, and obsolete in *Oreortyx*, and both the renal bar and posterior process are excavated by the renal depression in these genera. The renal bar is broad and the bar, but the posterior process is not excavated by the renal depression in *Odontophorus*, *Dactylortyx*, *Cyrtonyx*, and *Rhynchortyx*. The bar is only slightly excavated in *Rhynchortyx*.

The ischium lies at an agle of about 160 degrees to the ventral edge of the posterior iliac crest in most New World quail, but it lies at an angle of about 145 degrees to the ventral edge of the posterior iliac crest in *Cyrtonyx*.

The synsacrum of *Dendrortyx* is long and narrow, with a 55 per cent ratio of the width through the transverse processes of the fourth synsacral vertebra divided by the length of the synsacrum from the centrum of the first synsacral vertebra through the transverse process of the fourth synsacral vertebra is 55 per cent. The synsacra of *Rhynchortyx* and *Dactylortyx* are much shorter and wider, with the ratio 88-93 per cent in *Dactylortyx*, and 92 per cent in *Rhynchortyx*. The other genera have the synsacrum shorter and wider than *Dendrortyx*, and longer and narrower than *Rhynchortyx* and *Dactylortyx*, but are poorly separable among themselves.

Femur.--The head is moderately enlarged in most forms, but it is much enlarged in *Dactylortyx* and is variable in *Lophortyx*. The head is neither bent dorsally nor rotated posteriorly in most genera, but it is bent dorsally and without posterior rotation in *Rhynchortyx*, and bent dorsally and rotated posteriorly in *Dendrortyx*.

The neck is only moderately long in most New World quail, but it is long in *Dendrortyx*, and short in *Cyrtonyx*.

The iliac facet is without compression, and its dorsal border is flat in most genera, but it is compressed with its posterior border straight in *Dendrortyx*.

The dorsal crest of the trochanter is compressed and reflected with its dorsal border rounded in *Philortyx*, *Oreortyx*, *Callipepla*, *Dactylortyx*, usually compressed and reflected with the dorsal border rounded in *Lophortyx*, depressed and deflected with its dorsal border flat in *Dendrortyx*, *Odontophorus*, and *Cyrtonyx*, obsolete and flattened in *Rhynchortyx*, and variable in *Colinus*.

The trochanteric ridge is about 20-25 per cent of the length of the femur in most New World quail, but the ratio is only 12 per cent in *Rhynchortyx*.

The distal depth is about 80-90 per cent of the distal width in most genera, but the ratio is 71 per cent in *Rhynchortyx*, and 97 per cent in *Philortyx*.

The internal condyle is moderately wide and has its anterior border much produced throughout in most forms. *Cyrtonyx* differs only in that the anterior border of the internal condyle is weakly produced throughout. *Dactylortyx* differs in that the internal condyle is narrow and usually has its anterior border weakly produced throughout, whereas in *Philortyx* the anterior border of the internal condyle is very wide, and its anterior border is moderately produced throughout.

The external condyle is compressed and rounded anteriorly in most New World quail, but it is depressed and flattened anteriorly in *Dendrortyx*.

Tibiotarsus.--The depth of the inner cnemial crest is well over 50 per cent of its length in most New World quail, but the ratio is 42-48 per cent in *Dactylortyx*, 45 per cent in *Philortyx*, and 37-46 per cent in *Cyrtonyx*.

The outer cnemial crest is straight in *Oreortyx*, *Odontophorus*, and *Dactylortyx*, usually straight in *Callipepla*, *Colinus*, and *Cyrtonyx*, decurved in *Dendrortyx*, *Philortyx*, and *Rhynchortyx*, and variable in *Lophortyx*.

The interarticular tubercle is weakly produced in *Philortyx*, *Dactylortyx*, *Cyrtonyx*, moderately produced in *Dendrortyx*, *Callipepla*, *Lophortyx*, and *Rhynchortyx*, usually moderately produced in *Colinus*, moderately or strongly produced in *Odontophorus*, and strongly produced in *Oreortyx*.

The area between the external articular surface and outer cnemial crest is moderately concave in dorsal view in most New World quail, moderately or deeply concave in *Odontophorus*, and very deeply concave in *Dactylortyx*.

The posterior margin between the external and internal articular surface has a distinct notch in most genera, but it is weakly notched in *Dendrortyx*.

In most New World quail the area just anterior to the ridge for the proximal internal ligamental attachment lacks the deeply excavated depression present in Dendrortyx.

The area of the internal ligamental attachment on the internal condyle is moderately produced as a prominence in most New World quail, strongly produced in Dendrortyx, and without a prominence in Dactylortyx and Rhynchortyx.

The face of the internal condyle is moderately excavated with its border moderately elevated in most genera, but it is well excavated with its border highly elevated in Dendrortyx, and weakly excavated with slightly elevated border in Rhynchortyx.

The dorsal border of the supratendinal bridge is straight in Philortyx, Callipepla, Dactylortyx, and Cyrtonyx, usually straight in Oreortyx, Lophortyx, and Odontophorus, oblique in Dendrortyx and Rhynchortyx, and variable in Colinus.

Tarsometatarsus.---The intercotylar prominence is moderately deflected in most New World quail, but it is much deflected in Philortyx, only slightly deflected in Dactylortyx, and depressed and without deflection in Rhynchortyx. The apex of the intercotylar prominence is pointed in Dendrortyx, Philortyx, Lophortyx, Odontophorus, and Cyrtonyx, usually pointed in Oreortyx, Callipepla, Colinus, and Dactylortyx, and broadly rounded in Rhynchortyx.

The posterior intercotylar area is moderately excavated as a triangular depression in Dendrortyx, Odontophorus, and Dactylortyx, usually moderately excavated as a triangular depression in Cyrtonyx, weakly excavated as a triangular depression in Philortyx, Colinus, and Callipepla, usually weakly excavated as a triangular depression in Lophortyx, unexcavated in Rhynchortyx, and usually unexcavated in Oreortyx.

The area surrounding the posterior opening of the inner proximal foramen is shallowly excavated in Oreortyx, Callipepla, Colinus, Lophortyx, and Rhynchortyx, moderately excavated in Dactylortyx and Cyrtonyx, deeply excavated in Dendrortyx and Philortyx, and very deeply excavated in Odontophorus.

The hypotarsus has two well developed and one obsolete calcaneal ridges in most genera, but there are two well developed and one weakly developed calcaneal ridges in Dactylortyx, and three well developed calcaneal ridges in Rhynchortyx. The hypotarsus has two closed calcaneal canals in most New World quail, but there is only one closed calcaneal canal in Dendrortyx and Rhynchortyx, usually one in Oreortyx, and the condition is variable in Odontophorus.

The anterior face of the shaft is extensively excavated by the anterior metatarsal groove in Dendrortyx, Philortyx, and Rhynchortyx, moderately excavated by the anterior metatarsal groove in Callipepla, usually moderately excavated by the anterior metatarsal groove in

Colinus and Cyrtonyx, usually reduced in Lophortyx, reduced in Odontophorus, reduced or obsolete in Dactylortyx, and reduced or absent in Oreortyx.

The trochlea for digit II is only slightly inflected in most New World quail but is moderately inflected in Oreortyx, Dactylortyx, and Cyrtonyx.

The wing of the trochlea for digit IV is depressed dorsoventrally with the entire trochlea much deeper than long in most genera, but in Dendrortyx and Odontophorus the wing is depressed anteroposteriorly, and the entire trochlea is longer than deep.

Intermembral proportions.—The ratio of the combined length of the bones of the wing (humerus, ulna, carpometacarpus) divided by the combined length of the bones of the leg (femur, tibiotarsus, tarsometatarsus) divides the New World quail into three groups. Dendrortyx has a relatively short wing with a ratio of 52 per cent. Cyrtonyx and Dactylortyx have relatively long wings as this ratio is 78-81 per cent in Cyrtonyx and 72-73 per cent in Dactylortyx. The other forms are intermediate; the ratio ranges from 60-69 per cent, with considerable overlap between genera.

The ulna is more than 95 per cent of the length of the humerus in Odontophorus, Dactylortyx, and Rhynchortyx. The other forms range from 86-94 per cent in this ratio, with much overlap between genera.

The tarsometatarsus is more than 85 per cent of the length of the femur in Dendrortyx and Rhynchortyx, and 84-87 per cent in Odontophorus. The other forms range from 70-83 per cent in this ratio, with much overlap between genera.

The tarsometatarsus is 63 per cent or more the length of the tibiotarsus in Dendrortyx, Odontophorus, and Rhynchortyx. The other forms range from 53-61 per cent in this ratio, with considerable overlap between genera.

The humerus is 71 per cent of the length of the femur in Dendrortyx, but 90-91 per cent in Dactylortyx, and 95-100 per cent in Cyrtonyx. The other forms are indeterminate, and this ratio ranges from 80-88 per cent, with considerable overlap between genera.

The humerus is 51 per cent of the length of the tibiotarsus in Dendrortyx, and 72-75 per cent in Cyrtonyx. The other New World quail are intermediate, and this ranges from 58-67 per cent, with much overlap between genera.

The ulna is 63 per cent of the length of the femur in Dendrortyx, 87 per cent in Rhynchortyx, 88-91 per cent in Dactylortyx, and 89-93 per cent in Cyrtonyx. The other forms are intermediate, and the ratio ranges from 68-85 per cent, with considerable overlap between genera.

The ulna is 45 per cent of the length of the tibiotarsus in Dendrortyx, 65-66 per cent in Dactylortyx, and 68-71 per cent in Cyrtonyx. The other New World quail are intermediate, and the ratio ranges from 50-62 per cent, with much overlap between genera.

The ulna is 72 per cent of the length of the tarsometatarsus in Dendrortyx and 126-133 per cent in Cyrtonyx. The other New World quail are intermediate, and this ratio ranges from 87-111 per cent, with considerable overlap between genera.

The carpometacarpus is 27 per cent of the length of the tibiotarsus in Dendrortyx, and 38-40 per cent in Cyrtonyx. The other forms are intermediate, and this ratio ranges from 31-36 per cent, with much overlap among genera.

The carpometacarpus is 42 per cent of the length of the tarsometatarsus in Dendrortyx, and 71-74 per cent in Cyrtonyx. The other forms are intermediate, and the ratio ranges from 54-66 per cent, with much overlap between genera.

The tarsometatarsus is 124 per cent of the length of the humerus in Dendrortyx, but only 70-74 per cent in Cyrtonyx. The other New World quail are intermediate and this ratio ranges from 85-101 per cent, with considerable overlap between genera.

The ilium is 89 per cent of the length of the sternum in Dendrortyx, whereas this ratio ranges from 65-78 per cent in the other forms, with much overlap between genera.

The height of the sternal carina is 34 per cent of the length of the ilium in Dendrortyx, and 52 per cent in Rhynchortyx. The other forms are intermediate, and this ratio ranges from 37-49 per cent, with much overlap between genera.

Major Relationships

The New World quail may be divided into two distinct groups on the basis of striking differences in pelvic structure. One group will herein be referred to as the *Dendrortyx* group, and as having the *Dendrortyx* type of pelvis, whereas the other group will be referred to as the *Odontophorus* group, and as having the *Odontophorus* type of pelvis. The following genera are included in the two groups:

Dendrortyx group

Dendrortyx
Philortyx
Oreortyx
Callipepla
Colinus
Lophortyx

Odontophorus group

Odontophorus
Dactylortyx
Cyrtonyx
Rhynchortyx

Differences in the two basic pelvic types are outlined below. (1) In the *Dendrortyx* type the pectineal process is moderately produced beyond the acetabular border. In the *Odontophorus* type the pectineal process is represented only by a minute point or is absent. (2) In the *Dendrortyx* type the depression on the medial side of the pectineal process is distinct. In the *Odontophorus* type the depression is obsolete or absent. (3) In the *Dendrortyx* type the posterior iliac crest is without a prominence. In the

Odontophorus type a prominence is usually produced from the posterior iliac crest. (4) In the *Dendrortyx* type a ridge originates on the posterior iliac crest at the level of the ilio-ischiac fenestra, continues ventrad and posteriad towards the posterior border of the ilium, and has a prominence that arises from its posterior portion. In the *Odontophorus* type the ridge and prominence are absent, except in one specimen of *Odontophorus gujanensis*. (5) In the *Dendrortyx* type the dorsal face of the post-acetabular ilium is relatively short and broad. In the *Odontophorus* type the dorsal face of the post-acetabular ilium is relatively long and narrow. (6) In the *Dendrortyx* type the caudal face of the post-acetabular ilium is enlarged, triangular, vertical in position, and its posterodorsal apex forms the posteromedial wall of the posterior process. In the *Odontophorus* type the caudal face of the post-acetabular ilium is obsolete, variable in shape, horizontal in position, and forms the ventral floor of the posterior process. (7) In the *Dendrortyx* type the lateral face of the post-acetabular ilium is relatively short. In the *Odontophorus* type the lateral face of the post-acetabular ilium is relatively long. (8) In the *Dendrortyx* type the renal bar is very poorly developed or obsolete, always slender, and both the bar and the posterior process are excavated by the renal depression. In the *Odontophorus* type the renal bar is well developed and broad, and the bar, but not the posterior process, is excavated by the renal depression.

The *Dendrortyx* Group

The major skeletal modifications and possible affinities of the genera in the *Dendrortyx* group are discussed in the following paragraphs.

Dendrortyx.--This genus appears to be the most primitive, as well as the most aberrant genus of the New World quail.

Numerous characters of *Dendrortyx* are suggestive of those in less advanced gallinaceous families. (1) The dorsal intermuscular line of the coracoid is sharply raised only along its distal fifth. (2) The ventral intermuscular line of the coracoid terminates in the middle of the distal border of the sterno-coracoidal process. (3) The dorsal face of the coracoid has a round, deep fossa, below the tubercle for the ligamentum sterno-coracoideum dorsale, and above the external end of the sternal facet. This is probably a remnant of the deep pneumatic fossa found in this position in several less advanced families. (4) The tip of the sterno-coracoidal process of the coracoid is without a terminal knob. (5) The depression on the medial side of the pectineal process of the pelvis is perforated by a foramen. (6) The fossa II of the humerus is indistinct. (7) The hypotarsus has only one closed calcaneal canal.

At the same time Dendrortyx is the most aberrant genus of New World quail, since it has 30 unique characters excluding intermembral proportions, and 41 unique characters including these proportions. The distinctive intermembral proportions in Dendrortyx reflect the fact that the leg bones are very long in comparison with the wing bones, the ilium very long in comparison with the sternum, and the height of the sternal carina low in comparison with the length of the ilium. Dendrortyx has the largest measurements in the Dendrortyx group.

Philortyx.--Philortyx is possibly the closest living relative of Dendrortyx, with which it shares the four following skeletal characters. (1) The capital groove of the humerus is deeply excavated and has its internal margin strongly elevated. (2) The height of the middle of the shaft of the ulna is about 85 per cent of the height of the shaft just distal to the external cotyla. (3) The pisiform process of the carpometacarpus is round in internal view. (4) The external condyle of the ulna has its ventral border flattened. Philortyx has eight unique characters, but aside from its small size, it does not show striking skeletal modifications.

Oreortyx.--This genus appears to show more relationships to Colinus, Lophortyx, and especially to Callipepla (on characters on the scapula, and in pelvic proportions), than it does to *Dendrortyx* and *Philortyx*. *Oreortyx* has six unique characters, but other than its relatively large size measurements, it shows no particularly noteworthy skeletal modifications.

Callipepla, *Colinus*, and *Lophortyx*.--In many cases the genera of this complex cannot be separated on the basis of individual bones, and there is not a single unique generic character. In short *Callipepla*, *Colinus*, and *Lophortyx* are so similar in skeletal structure that it would be very tempting to include them in a single genus were it not for the fact that the species fall into three separate groups on external morphology. It appears that *Callipepla*, *Colinus*, and *Lophortyx* have diverged relatively recently, and subgeneric rather than generic designations might better reflect their taxonomic status.

Other studies support this view. Bailey (1928) reports a hybrid *Callipepla squamata* x *Lophortyx gambelii*. Sibley (1960) states that species of *Colinus*, *Lophortyx*, and *Callipepla* hybridize in various combinations. Sibley (op. cit.) also reports that *Callipepla*, *Colinus*, and *Lophortyx* share a characteristic egg-white protein profile, different from that of *Oreortyx*.

The *Odontophorus* Group

The major skeletal modifications and possible affinities of the genera of the *Odontophorus* group are discussed in the following paragraphs.

Odontophorus.--This genus appears to be the most primitive of the Odontophorus group. Several important characters of Odontophorus are found in less advanced gallinaceous families. (1) The pneumatic fossa of the humerus has a perforated inner shelf that extends from the external bicipital surface to the medial bar in Odontophorus gujanensis. (2) The fossa II of the humerus is indistinct. (3) The hypotarsus has only one closed calcaneal canal in Odontophorus stellatus.

The large size of Odontophorus in comparison with those of other New World quail possibly indicates a primitive trait in this genus, for there seems to be a progressive trend towards decrease in size of the more advanced Galli. The trend is summarized as follows:

General Size of Galli

Megapodiidae: all large
Cracidae: very large to large
Numididae: all large
Meleagrididae: all very large
Phasianidae: large, a few very small
Tetraonidae: very large to large
Odontophoridae: small to very small

Some very noteworthy characters occur on the pelvis of certain specimens of Odontophorus. (1) The posterior iliac crest of the pelvis has a prominence in all Odontophorus studied, with the exception of one individual of Odontophorus gujanensis. (2) A ridge originates on the posterior iliac crest at the level of the ilio-ischiac fenestra, continues ventrad and posteriad towards the posterior border of the ilium, and has a prominence that arises from its posterior surface in one individual of Odontophorus gujanensis.

These characters have interesting implications, for they are associated with the Dendrortyx type of pelvis and are not found in any other genus in the Odontophorus group. Dendrortyx certainly appears to be the most primitive genus of New World quail, and thus it would seem probable that the Dendrortyx type of pelvis was evolved earlier than the Odontophorus type. Therefore the occasional occurrence of these characters in a primitive genus of the Odontophorus group is not surprising.

Further substantiating the primitive nature of Odontophorus is the fact that it shares three characters with Dendrortyx only, namely: (1) large size; (2) an indistinct fossa II of the humerus; (3) the wing of the trochlea for digit IV depressed anteroposteriorly and the entire trochlea is longer than deep.

Odontophorus is a rather generalized form, with much specific variation and with only two unique characters.

Dactylortyx.--This genus has 10 unique characters but still does not show as many skeletal modifications as the following two genera. Perhaps the most important skeletal modifications in Dactylortyx are the tendency towards the loss of the pectineal process, with the complete loss of the depression on the medial side of the pectineal process, and the elongation of the bones of the wing in comparison with the bones of the leg. Dactylortyx is relatively large. It appears to be more closely related to Cyrtonyx, somewhat more distantly related to Rhynchortyx, and most distantly related to Odontophorus on the basis of several qualitative characters, as well as on intermembral proportions.

Cyrtonyx.--This form has 15 unique characters. Important skeletal modifications include the very strong deflection of the acromion process of the scapula, the weak development of the intermetacarpal tubercle of the carpometacarpus, the narrow angle of the ischium to the ventral edge of the posterior iliac crest, and as in Dactylortyx the elongation of the bones of the wing in comparison to the bones of the leg. Cyrtonyx also has relatively large size measurements. It appears most closely related to Dactylortyx, somewhat more distantly related to Rhynchortyx, and most distantly related to Odontophorus, on the basis of several qualitative characters as well as on intermembral proportions.

Rhynchortyx.--This is the most aberrant genus of the Odontophorus group, as it has 25 unique characters. Important skeletal modifications include the short, deep, rostrum and the development of a third distinct calcaneal ridge on the hypotarsus. Rhynchortyx has the smallest measurements of any genus in the Odontophorus group. In several qualitative characters, as well as on intermembral proportions, Rhynchortyx appears more closely related to Cyrtonyx and Dactylortyx than to Odontophorus.

Remarks

In summary Dendrortyx appears to be at once the most primitive and aberrant genus of the New World quail. Philortyx is possibly its closest relative. Oreortyx is closely related to Colinus, Lophortyx, and especially to Callipepla. Callipepla, Colinus, and Lophortyx are so similar that on osteological grounds they might best be merged in a single genus.

Odontophorus appears to be the most primitive genus in the Odontophorus group. Dactylortyx and Cyrtonyx show several similarities and appear closer to Rhynchortyx than to Odontophorus. Rhynchortyx is the most aberrant genus of the Odontophorus group.

On the basis of the present study, the following rearrangement is proposed:

Sequence of genera in Peters (1934)	Proposed sequence of genera
Dendrortyx	Group 1
Oreortyx	*Dendrortyx*
Callipepla	*Philortyx*
Lophortyx	*Oreortyx*
Philortyx	*Callipepla*
Colinus	*Colinus*
Odontophorus	*Lophortyx*
Dactylortyx	Group 2
Cyrtonyx	*Odontophorus*
Rhynchortyx	*Dactylortyx*
	Cyrtonyx
	Rhynchortyx

FOSSIL RECORD OF NEW WORLD QUAIL

American quail are reported from Oligocene to Recent times, but the single Oligocene form is indeterminate at the generic and specific levels. Modern genera are first recorded from the Miocene series, and modern species first appear in the Pleistocene.

Tertiary Forms

Odontophoridae, indeterminate

Horizon and locality.--Oligocene: silts of Orellan age in the Cedar Creek facies of the White River formation. From SW 1/4 sec. 12, T. 11. N., R 54 W., Logan County, Colorado (Tordoff, 1951b).

Material.--Distal end of a tarsometatarsus (University of Kansas Natural History Museum).

Remarks.--Tordoff states that the Oligocene fossil is smaller than Colinus and Lophortyx, but it most closely resembles these genera. It is very difficult to differentiate some American genera of quail (or even some gallinaceous families) on the distal portion of the tarsometatarsus, and the reported affinities of the Oligocene fragment should be regarded with some caution.

Miortyx A. H. Miller 1944

The genus is known from a single species recorded from the Lower Miocene of South Dakota.

Miortyx teres A. H. Miller 1944

Horizon and locality.--Lower Miocene: late Arikareean stage of Rosebud formation. From Flint Hill quarry, Bennett County, South Dakota (A. H. Miller, 1944).

Material.--Type, proximal three-fourths of right humerus, University of California Museum of Paleontology no. 34453. Referred specimen, distal end of left tibiotarsus.

Diagnosis.--"Proximal end of humerus similar to that of *Oreortyx* but decidedly larger; capital groove sharply defined and narrower, especially at margin of head; contour of head more smoothly rounded, less indented by capital groove; ligamental furrow on palmar surface deeper; tubercle on middle of deltoid crest proportionately larger."

Measurements.--"Type, greatest width of head of humerus perpendicular to axis of upper part of shaft, 12.9 mm.; least width of shaft, in mediolateral direction, 5.0."

Remarks.--A. H. Miller (1944) points out: "The most distinctive feature of *Miortyx* is the rounded contour of the head with consequent shallow depression between the articular surface of the head and the internal tuberosity. *Dendrortyx* of Central America approaches, but by no means equals *Miortyx* with respect to lesser indentation of the head contour by the capital groove."

In the living Odontophoridae fossa II of the humerus is usually well developed. Dendrortyx and Odontophorus are apparently less specialized exceptions in which fossa II is obsolete. The drawing of the type specimen of Miortyx teres (A. H. Miller, 1944, p. 94, fig. 7) indicates that fossa II, though not obsolete, is rather weakly developed.

Cyrtonyx Gould 1844

The genus is reported from the Upper Miocene of California and Nebraska, and from the Pleistocene of Aramberri, Nuevo Leon, Mexico.

Cyrtonyx cooki Wetmore 1934

Horizon and locality.--Upper Miocene: upper Sheep Creek beds. From 17 miles south of Agate, Sioux County, Nebraska (Wetmore, 1934).

Material.--Type, distal half of left humerus, collection of Harold J. Cook, no. H. C. 647.

Diagnosis.--"Distal end of humerus similar to that of Cyrtonyx montezumae mearnsi Nelson, but about one-fourth larger; ectepicondyle relatively reduced."

Measurements.--Greatest transverse breadth across condyles 9.5 mm.; least transverse breadth of shaft 4.6 mm.

Remarks.--Wetmore (1934) reports that the fossil is a northward extension of Cyrtonyx, which occurs today from central Arizona and central Texas southward into Guatamala.

Cyrtonyx tedfordi L. Miller 1952

Horizon and locality.--Upper Miocene: Barstow formation, Lake bed horizon. From near middle of SE 1/4, NW 1/4 sec. 15, T 11, N, R 2 W, near the town of Barstow, California (L. Miller, 1952).

Material.--Type, right carpometacarpus, University of California Museum of Paleontology no. 42223.

Diagnosis.--"Very similar to male of Cyrtonyx montezumae mearnsi, but much stouter, and with intermetacarpal tubercle much less developed."

Remarks.--This fossil needs restudy. The photograph of the type carpometacarpus (L. Miller, 1952 p. 299, fig. 2) shows the following characters: (1) pisiform process reduced, and at the level of its ligamental attachment. (2) intermetacarpal tubercle obsolete, represented only by a minute point. (3) carpal trochlea with its external rim continuing distad beyond ligamental notch. These are strong characters of the family Cracidae and do not occur in any living genus of American quail. It is thus possible that the above fossil represents a small species of the Cracidae.

Colinus Goldfuss 1820

The genus is reported from the late Pliocene of Arizona and Kansas, the Pleistocene of Florida and Texas, and prehistoric deposits from caves in Yucatan, Florida, Texas, and Tennessee.

Colinus sp.

Horizon and locality.--Upper Pliocene. From sec. 22, T 17 S, R 20 E, about two miles south of Benson, Arizona (Wetmore, 1924).

Material.--Distal portion of tarsometatarsus (United States National Museum).

Remarks.--The fossil has a smaller and narrower middle trochlea than Callipepla, and a lower distal foramen than either Colinus virginianus or Lophortyx gambelii (Wetmore, 1924).

Colinus hibbardi Wetmore 1944

Horizon and locality.--Upper Pliocene: Rexroad formation. From Locality 3, Rexroad fauna, Meade County, Kansas (Wetmore, 1944).

Material.--Type, distal portion of right tarsometatarsus, with most of the outer trochlea missing, University of Kansas Museum of Vertebrate Paleontology no. 3981. Referred specimens, distal end of right humerus and distal end of badly worn left humerus.

Diagnosis.--"Distal end of tarsometatarsus (figs. 4 and 5) similar to that of modern Colinus virginianus (Linnaeus) but decidedly larger; shaft stronger, and more heavily lined by the tendinal grooves."

Measurements.--Type: "Transverse breadth of shaft below center, 3.1 mm.; transverse breadth across trochlea (approximate), 7 mm.; transverse breadth of middle trochlea, 2.9 mm."

Remarks.--Wetmore (1944) reports that the type tarsometatarsus shows more angular development of the posterior side of the middle trochlea than in Lophortyx, stouter form throughout than in Callipepla, and larger trochleae than in Cyrtonyx. The referred humerus (University of Kansas Museum of Vertebrate Paleontology 3997) shows similarities to Colinus virginianus, but the brachial depression is larger, and the ridge that borders it is longer and extends farther up the shaft. In size it is similar to adult male Cyrtonyx montezumae mearnsi, but the trochleae are definitely smaller. The radial trochlea is larger than in Callipepla. All of the above fossils are larger than Colinus virginianus.

Tordoff (1951a) reports on 32 bones of Colinus hibbardi from the type locality. Fossil elements include five vertebrae, three sterna, seven coracoids, one humerus, five ulnae, seven carpometacarpi, and four tarsometatarsi. Tordoff finds that the fossils are similar to the bones of Recent Colinus virginianus but larger, and the wing bones are longer in relation to the leg bones. Subjective differences include the following characters: (1) Ventral intermuscular line of coracoid less prominent and less sharply defined than in Recent C. virginianus. (2) Shaft of humerus straighter and heavier, and brachial depression larger. (3) Impression of M. brachialis anticus on ulna deeper and more sharply outlined. (4) Intercotylar prominence of tarsometatarsus more nearly round, depression just over posterior edge of internal cotyla more angular and sharply marked, and the ridge leading proximad from the outer proximal foramen more sharply defined.

Odontophoridae, indeterminate

Horizon and locality.--Upper Pliocene. From sec. 25, T 18 S, R 21 E, about 14 miles southeast of Benson, Arizona (Wetmore, 1924).

Material.--Proximal end of a humerus (United States National Museum).

Remarks.--Wetmore notes that this fragment is large as in *Oreortyx*, but has characters like *Colinus*. It seems possible that the specimen represents *C. hibbardi*.

Lophortyx Bonaparte 1838

The genus is reported from the middle Pliocene of Oregon, the Pleistocene of California, and from archaeological sites in California and Arizona.

Lophortyx shotwelli Brodkorb 1958

Horizon and locality.--Middle Pleistocene: Hemphillian stage. From tuffaceous sandstone on the east bank of McKay Reservoir, about five miles south of Pendleton, Umatilla County, Oregon (Brodkorb, 1958).

Material.--Type, proximal portion of left humerus, University of Oregon Museum of Natural History, no. F-3611. Referred material, proximal portion of left humerus, and distal portion of two left humeri.

Remarks.--The type material was available for examination during the present study through the kindness of Dr.

Brodkorb and the University of Oregon Museum of Natural History.

A description based on this re-examination is as follows: Humerus with (1) Greatest proximal width 9.8 mm. in type specimen (referred specimen broken). (2) Greatest distal width 7.3-7.3 mm. (7.30 mm.). (3) Pneumatic fossa moderately elongate, elliptical, reduced in its distal extent, and with a vestigial, perforated, inner shelf. (4) Median crest strongly developed, elevated throughout. (5) Capital groove moderately excavated with its internal margin moderately elevated. (6) Margin between head and internal tuberosity moderately concave. (7) Head about as long as broad in anconal view. (8) Ridge along medial border of fossa II moderately swollen, elongate, and with its apex acute. (9) Fossa II well developed. (10) Latissimus ridge originating on lateral edge of shaft, but swinging in onto anconal face proximally. (11) External tuberosity weakly inflated. (12) Bicipital crest arising gently from shaft, narrowly rounded, with its distal border lacking a groove. (13) Deltoid crest moderately developed, slightly inflected, and with its summit flattened in type specimen (knob-like in referred specimen). (14) Entepicondyle at level of internal condyle. (15) Entepicondylar prominence moderately produced, with its pit placed on internal face. (16) Depression of M. brachialis anticus moderately excavated.

Several of the above characters are noteworthy. Perhaps most interesting is the vestigial, perforated, inner shelf of the pneumatic fossa of the humerus. An imperforate, complete inner shelf is present in most other families of the Galli, but has been lost in all living New World quail with the exception of *Odontophorus gujanensis*, which retains a perforated inner shelf. *Lophortyx shotwelli* differs from all Recent species of *Lophortyx* in characters 3, 4, 11, and 14 above, and shares character 7 with Recent *Dendrortyx*, *Philortyx*, and *Lophortyx douglasii* only.

Pleistocene Forms

Dendrortyx Gould 1844

The genus is reported from the Pleistocene of Nuevo Leon, Mexico, and tentatively from a prehistoric deposit in a Yucatan cave (Fisher, 1953).

Dendrortyx (?) sp.

Horizon and locality.--Pleistocene. From San Josecito Cavern, province of Aramberri, state of Nuevo Leon, Mexico (L. Miller, 1943).

Material.--A single femur (University of California Museum of Vertebrate Paleontology).

Remarks.--L. H. Miller reports that the above femur is larger and heavier than that of a Recent specimen of *Dendrortyx leucophrys nicaraguae*, but the fossil is not identified to species.

Oreortyx Baird 1858

Reported from the late Pleistocene of California, and from the Quaternary (probably prehistoric) of a New Mexico cave.

Oreortyx picta (Douglas) 1829

Horizon and locality.---(a) Late Pleistocene. From Potter Creek Cave, Shasta County, California (L. Miller, 1911).

(b) Late Pleistocene. From Samwel Cave, Shasta County, California (L. Miller, 1912).

(c) Late Pleistocene. From Hawver Cave, Eldorado County, California (L. Miller, 1911).

Material.---(a) Potter Creek Cave; two bones. (b) Samwel Cave; not listed. (c) Hawver Cave; 14 bones. Bones from the above localities are at the University of California Museum of Vertebrate Paleontology.

Neortyx new genus

Type of genus.---Neortyx peninsularis new species.

Diagnosis.---Differs from living genera of New World quail as follows. (1) Femur with proximal end narrow throughout, with head and trochanter small, but with shaft expanding abruptly into enlarged distal end (in living genera proximal end wider throughout, with head and trochanter larger, and with shaft expanding less abruptly into less enlarged distal end). (2) Anterior border of external condyle extending well onto distal portion of shaft as a strong ridge (anterior border of external condyle ending more abruptly on distal portion of shaft as a weak ridge in living genera). (3) Internal lip of external condyle reflected (deflected in living genera). (4) Dorsolateral border of iliac facet short (longer in living genera).

Closest to more specialized genera of the Dendrortyx group in having (1) head neither bent dorsad nor rotated posteriad, thus differing from Dendrortyx and Rhynchortyx. (2) Neck moderately long, thus differing from Dendrortyx. (3) Iliac facet without compression, with posterior border convex, thus differing from Dendrortyx. (4) Dorsal crest of trochanter broken. (5) Trochanteric ridge 24 per cent of length of shaft, thus differing from Rhynchortyx and Dactylortyx. (6) Distal depth 83 per cent of distal width, thus differing from Philortyx and Rhynchortyx. (7) Internal condyle moderately wide, and with its anterior border much produced throughout, thus differing from Philortyx, Cyrtonyx, and Dactylortyx. (8) External condyle compressed and rounded anteriorly, thus differing from Dendrortyx.

Neortyx peninsularis new species

Holotype.--Left femur, complete except for broken dorsal crest of trochanter, PB 1224 (Brodkorb collection, University of Florida). Pleistocene: Arredondo clay equivalent, in pit of Dixie Lime Products Company in the SW corner, NW 1/4 sec. 14, T 13 S, R 21 E, Marion County, Florida, one mile southeast of the town of Reddick. Collected by Pierce Brodkorb

August 9, 1954.

Measurements of holotype.--Length through articular facet, 45.8 mm., greatest proximal width, 7.5 mm., distal width through condyles, 7.6 mm., greatest proximal width/length 16.4 per cent, distal width through condyles/greatest proximal width 101.3 per cent, proximal width of shaft/width of shaft just proximad to internal condyle 65.2 per cent.

Diagnosis.--Femur larger than in Philortyx fasciatus, Oreortyx picta, Callipepla squamata, Colinus suilium, C. virginianus, C. nigrogularis, C. leucopogon, Lophortyx californica, L. gambelii, L. douglasii, Dactylortyx thoracicus, and Cyrtonyx montezumae; smaller than in Dendrortyx leucophrys, Odontophorus gujanensis, O. stellatus, and O. guttatus (Table 7).

Referred material.--The following elements from the Pleistocene of Reddick, Florida, are referred to the above species. One complete and two fragmentary right coracoids (PB 478, 1275, and 1974), and two fragmentary right ulnae (PB 935 and 1229).

Coracoid: Internal distal angle short, rounded terminally, and with its dorsal surface flattened (internal distal angle elongate, pointed terminally, and with its dorsal surface round in living genera). Length, 29.0 mm., proximal width 4.3 mm., distal width (two specimens), 8.7-8.8 mm., distal width/length 30.3 per cent, proximal width/distal width 48.9 per cent, proximal width/length 14.8

per cent.

Ulna: Olecranon process only moderately produced (strongly produced in most living genera, weakly produced in Rhynchortyx). Greatest proximal width 6.0-6.3 mm.

Remarks.--This is the second extinct genus of New World quail described and brings the total of extinct and living genera to 12. The type specimen shows several resemblances to Oreortyx, Callipepla, Colinus, and Lophortyx, but is certainly quite distinct from these forms, as it has four characters unique among New World quail. The referred elements show two unique characters, but otherwise are similar to birds in the Callipepla-Colinus-Lophortyx complex in qualitative characters, as well as in size.

Colinus Goldfuss 1820

Colinus suilium Brodkorb 1959

Horizon and locality.--Pleistocene: Arredondo clay member of Wicomico formation. From Pits I and II in limestone quarry in NW 1/4 sec. 22, T 10 S, R 9 E, near Arredondo, Alachua County, Florida (Brodkorb, 1959).

Material.--Holotype, Pit I: complete left humerus, Brodkorb collection, no. 1291; paratype, complete right humerus, no. 757. Referred material, Pit I: one sternum, two coracoids, four humeri, three ulnae, one carpometacarpus, one synsacrum, three tibiotarsi, three tarsometatarsi. Pit II: two coracoids, one scapula, one ulna, four humeri, two femora, three tibiotarsi, and one tarsometatarsus (Brodkorb collection, University of Florida).

Diagnosis.--For the original description the reader is referred to Brodkorb (1959, p. 276).

Status of the Arredondo clay.--The Arredondo clay member of the Wicomico formation consists mainly of blue clay streaked with yellow, that weathers to brown. It was deposited under terrestrial conditions of sedimentation and contains fossils of fresh-water gastropods and vertebrates. Arredondo clay lies beneath the Wicomico terrace, a reddish-brown marine sand. The exact age of the Wicomico formation is uncertain at present, but it is possible that it represents either Yarmouth or Sangamon interglacial deposition (Brodkorb, personal communication). Therefore, the Arredondo clay may represent either Kansan or Illinoian times.

Other localities.--Fossil bones assigned to the species Colinus suilium from other fossil localities in Florida are listed in the next paragraphs, but they will be discussed in a following section on variation in fossil Colinus.

(a) Williston, Florida. Pleistocene: Arredondo clay. From sink-hole in Connell and Shultz Limerock Company mine, 0.9 miles north of Seaboard Airline Railroad, Williston, Levy County, Florida (Holman, 1959a and 1959c). One rostrum, one coracoid, five humeri, one ulna, two carpometacarpi, four femora, three tibiotarsi, and one tarsometatarsus (Brodkorb collection, University of Florida).

(b) Orange Lake, Florida. Pleistocene; Arredondo clay and Arredondo clay-Wicomico sand contact. From sink-hole in limestone quarry near center of sec. 33, T 12 S, R 21 E, Marion County, Florida, two miles south of the town of Orange Lake (Holman, 1959b). Arredondo clay: eight coracoids, four scapulae, nine humeri, two ulnae, one carpometacarpus, ten femora, five tibiotarsi, five tarsometatarsi. Arredondo clay-Wicomico sand contact: one femur (Brodkorb collection, University of Florida).

(c) Reddick, Florida. Pleistocene: Arredondo clay equivalent. From localities A, B, C, and undesignated exact localities (either A or B) in pit of Dixie Lime Products Company in the SW corner, NW 1/4 sec. 14, T 13 S, R 21 E, Marion County, Florida, one mile southeast of the town of Reddick (Brodkorb, 1957).

Locality A: one sternum, five coracoids, nine humeri, two ulnae, two femora, five tibiotarsi, two tarsometatarsi. Locality B: three coracoids, six humeri, seven femora, two tibiotarsi, seven tarsometatarsi. Locality C: one rostrum, two coracoids, 15 humeri, four ulnae, nine carpometacarpi, one synsacrum, eight femora, four tibiotarsi, four tarsometatarsi. Locality A or B (undesignated): one rostrum, three sterna, 66 coracoids, nine scapulae, 138 humeri, 63 ulnae, 30 carpometacarpi, five synsacra, 90 femora, 77 tibiotarsi, 61 tarsometatarsi (Brodkorb collection, University of Florida).

The total of 644 bones from Reddick represents a relatively tremendous number of individual fossil bird bones. There are 74 left humeri from Reddick, so that a minimum number of 74 individuals is represented.

(d) Haile II, Florida. Pleistocene: Arredondo clay. From locality II B in NW 1/4, sec. 25, T 9 S, R 13 E, Alachua County, Florida, near the village of Haile (Auffenberg, 1955). A gragmental ulna and tibiotarsus (collection of Howard Hutchison at the University of Florida).

(e) Oakhurst Quarry, Florida. Pleistocene. From Oakhurst Limestone Quarry, two miles southeast of Ocala Post Office, Marion County, Florida. A single left humerus (Brodkorb collection, University of Florida). As no extinct vertebrates have been taken from this locality its age is uncertain.

(f) Zuber, Florida. Pleistocene; Arredondo clay equivalent. Dixie Lime Products Company mine, Zuber, Marion County, Florida. One femur (Brodkorb collection, University of Florida).

(g) Eichelberger Cave, Florida. Pleistocene (stratigraphy unclear). From Locality A in solution cave in NW corner of sec. 2, T 17 S, R 22 E, Marion County, Florida, two miles southwest of the town of Belleview (Brodkorb, 1956). One humerus, one femur, one tibiotarsus, and one tarsometatarsus (Brodkorb collection, University of Florida).

(h) Lake Monroe, Florida. Pleistocene. From Locality N, dredged from mouth of Lake Monroe, Volusia County, Florida.

associated with extinct Pleistocene vertebrates.

Specimens from localities (d) through (h) are tentatively referred to C. suilium, as they show an approach to C. virginianus in some respects.

Colinus virginianus (Linnaeus) 1758

Fossil bones assigned to the species Colinus virginianus are listed in the next paragraphs but will be discussed in the following section on variation in fossil Colinus.

(a) Kanapaha, Florida. Pleistocene (stratigraphy unclear). From limestone quarry in sec. 22 R 19 E, T 10 S, Alachua County, Florida, about 1.5 miles SW of the village of Arredondo (Brodkorb, 1958). Two humeri, one carpometacarpus, one femur, and one tibiotarsus (Brodkorb collection, University of Florida). The bones are from tan sand in solution holes in the Ocala limestone, but the relationship of the deposit to the Wicomico terrace is not well marked.

(b) Saber-tooth Cave, Florida. Pleistocene: post-Wicomico. From solution cave in NW 1/4, SW 1/4, sec. 33 T 18 S, R 18 E, Citrus County, Florida, 1.2 miles NW of the town of Lecanto. Two humeri, four carpometacarpi, three femora, two tibiotarsi (Brodkorb collection, University of Florida); and two humeri, two femora, and one tarsometatarsus (Holmes Collection, see Wetmore, 1931). Holman (1958) reports that the fossils lie in matrix derived from the Pamlico terrace. This is incorrect. The matrix was derived from the Wicomico terrace.

(c) Seminole Field, Florida. Pleistocene; post-Wicomico. From Joes Creek, 46th Avenue N., 71st St. N., St. Petersburg, Pinellas County, Florida (Wetmore, 1931). Six humeri and one ulna (Holmes collection, see Wetmore, 1931).

(d) Melbourne, Florida. Pleistocene: post-Wicomico. From line of contact between strata 1 and 2. From Country Club Golf Links, near Melbourne, Brevard County, Florida (Wetmore, 1931). Two humeri collected by J. W. Gidley in 1928 (Wetmore, 1931), appear to be lost at present.

(e) Vero, Florida. A heterochronic locality: stratum 2 (with extinct vertebrates), Pleistocene, pre-Pamlico; stratum 3 (without extinct vertebrates), Pleistocene or Recent, post-Pamlico; "West of Bridge," age uncertain. All sites in the center of sec. 35, T 32 S, R 39 E, Vero Beach, Indian River County, Florida (Weigel, 1958). Stratum 2, two humeri, one coracoid, and one tibiotarsus; stratum 3, two humeri, one ulna, and one tibiotarsus; "West of Bridge," one humerus (Brodkorb collection, University of Florida).

(f) Warren's Cave, Florida. Prehistoric? From floor of Warren's Cave, 8.5 miles NW of Gainesville, Alachua County, Florida. One scapula, one coracoid, and one tarsometatarsus (Brodkorb collection, University of Florida).

(g) Friesenhahn Cave, Texas. Late Pleistocene. From Friesenhahn Cave in northern Bexar County, Texas (Milstead, 1956). Four humeri, one ulna, and two tibiotarsi (Texas Memorial Museum collection 933-428, 933-447, 933-2186, 933-3042, 933-3199, 933-3041, and 933-3531).

Lophortyx Bonaparte 1838

Lophortyx californica (Shaw) 1798

Horizon and locality.---(a) Pleistocene. From Rancho La Brea asphalt beds in Los Angeles, Los Angeles County, California (Howard, 1930; Miller and DeMay, 1942).

(b) Pleistocene. From Fauna I and Fauna II of asphalt beds, McKittrick, California (L. Miller, 1935).

(c) Pleistocene. From asphalt beds of Carpinteria, California (DeMay, 1941).

(d) Pleistocene. San Pedro and Palos Verdes formations. San Pedro, California (L. Miller, 1914 and 1930; Howard, 1944 and 1949).

(e) Pleistocene. From Hawver Cave, Eldorado County, California (L. Miller, 1911).

Material.---(a) Rancho La Brea; 101 individuals. (b) McKittrick; Fauna I, three bones, Fauna II, 93 bones. (c) Carpinteria; nine individuals, 102 bones. (d) San Pedro; San Pedro formation, one coracoid, two humeri, one tibiotarsus, Palos Verdes formation, six bones. (e) Hawver Cave, 17 bones. Fossils from all the above localities are in the University of California Museum of Vertebrate Paleontology. Fossils from localities (a) and (d) are also in the Los Angeles County Museum. Lophortyx californica is the most abundant fossil quail in the western United States.

Cyrtonyx Gould 1844

Cyrtonyx montezumae (Vigors) 1830

Horizon and locality.---Pleistocene. From San Josecito Cavern, province of Aramberri, state of Nuevo Leon, Mexico (L. Miller, 1943).

Material.---Eighty bones, including limb bones, a coracoid, and two crania (University of California Museum of Vertebrate Paleontology).

Remarks.---According to L. Miller (1943) the fossil sample is very close to the subspecies C. montezumae mearnsi.

Odontophorus Vieillot 1816

The genus is reported from the Pleistocene of various caves in Brazil, and from a prehistoric site in a Yucatan cave.

Odontophorus gujanensis (Gmelin) 1789

Horizon and locality.---Pleistocene. From four cave deposits (Lapa da Escrivania, Lapa da Marinho, Lapa do Periperi, and Lapa Vermelha) near Lagoa Santa, Minas Geraes, Brazil (Winge, 1887).

Material.---A few bones from each cave (Copenhagen Museum).

Forms from Archaeological Sites

Remains of species of American quail living today are known from several archaeological sites. Dendrortyx leucophrys is questionably listed from a cave in Yucatan

(Fisher, 1953). Oreortyx picta is reported from a cave in New Mexico (Wetmore, 1932). Colinus virginianus is identified from caves in Tennessee and Texas (Shufeldt, 1897; Wetmore, 1933), and C. nigrogularis is reported from a cave in Yucatan (Fisher, 1953). Lophortyx californica and L. gambelii are listed from Indian sites in California and Arizona (DeMay, 1942; Wetmore, 1932). Odontophorus guttatus is questionably identified from a cave in Yucatan (Fisher, 1953).

Variation in Fossil Colinus

Wetmore (1944) named Colinus hibbardi from the upper Pliocene of Meade County, Kansas, and Brodkorb (1959) described Colinus suilium from the pre-Wicomico Pleistocene of Arredondo, Florida. These species were described on the basis of large size and several qualitative characters. Additional specimens of C. hibbardi and C. suilium were reported by Tordoff (1951a) and Holman (1959c). As pointed out by Brodkorb (1960), in all probability these forms are the temporal equivalents of living Colinus virginianus, and we are dealing with a continuum. Because the living species of Colinus are almost identical to each other in osteological characters and exhibit subspecific variation in size, it is extremely difficult to arrive at a taxonomic decision regarding where to draw the line between certain fossil populations of Colinus.

The variations found in fossil Colinus are discussed in the following paragraphs. It should be pointed out that the samples of fossil bones from many localities are too small to be statistically significant.

Qualitative Characters

Qualitative characters of fossil and Recent Colinus are summarized below.

Coracoid.--The head of the coracoid is reflected in the single fossil of C. hibbardi, in 63 per cent of 62 fossils of C. suilium from Arredondo, Orange Lake, and Reddick, and in 92 per cent of 86 modern specimens of C. virginianus and the two specimens of modern C. nigrogularis. It is inflected in two of three specimens of modern C. leucopogon.

The procoracoid process is weakly developed in C. hibbardi and is stronger in C. suilium, C. virginianus, C. nigrogularis, and C. leucopogon.

Scapula.--The dorsal depression just mediad to the glenoid facet is deep in 67 per cent of 15 fossils of C. suilium from Arredondo, Orange Lake, and Reddick, but is shallow in 77 per cent of 81 modern specimens of C. virginianus. The depression is deep in one of two specimens of living C. nigrogularis, and two of three specimens of living C. leucopogon.

The bridge between the acromion process and glenoid facet is usually about one-half the width of the glenoid facet in *C. suilium*, *C. virginianus*, and *C. leucopogon*, but is less than one-third the width of the glenoid facet in *C. nigrogularis*.

The acromion process is strongly inflected in 62 per cent of 13 fossils of *C. suilium* from Arredondo, Orange Lake, and Reddick. In the living species the process is only slightly inflected in 72 per cent of 80 specimens of *C. virginianus*, in one of two *C. nigrogularis*, and in two of three *C. leucopogon*.

Humerus.--The ridge along the medial border of fossa II is moderately swollen in fossil *C. suilium*, modern *C. virginianus*, and modern *C. leucopogon*, but is only slightly swollen in modern *C. nigrogularis*.

The bicipital crest is pointed in 51 per cent of 97 fossils of *C. suilium* from Arredondo, Williston, Orange Lake, and Reddick. It is rounded in 69 per cent of 83 specimens of living *C. virginianus*, in the single specimen of *C. nigrogularis*, and in the three specimens of living *C. leucopogon*.

The entepicondyle arises abruptly from the shaft in 20 per cent of 107 fossils of *C. suilium* from Arredondo, Williston, Orange Lake, and Reddick. The entepicondyle arises gently from the shaft in 97 per cent of 77 specimens of modern *C. virginianus* and in the three specimens of *C. leucopogon*.

The depression for M. brachialis anticus is very large in *C. hibbardi*, and in two of four fossils of *C. suilium* from Arredondo, but it is small in the living species of *Colinus*.

Carpometacarpus.--The process of metacarpal I is pointed in the single fossil of *C. hibbardi*, and in 63 per cent of 35 fossils of *C. suilium* from Arredondo, Williston, Orange Lake, and Reddick. It is pointed in 93 per cent of 44 specimens of living *C. virginianus*, but is rounded in the three specimens of *C. leucopogon*.

The pisiform process is much reflected dorsad and thus produced well above the dorsal rim of the inner carpal trochlea in 25 per cent of 32 fossils of *C. suilium* from Arredondo, Orange Lake, and Reddick. The process is slightly reflected dorsad and thus below or at the level of the inner carpal trochlea in all living species.

The notch between the proximal border of the process of metacarpal I is deep in the single fossil of *C. hibbardi* and in 80 per cent of 35 fossils of *C. suilium* from Arredondo, Williston, Orange Lake, and Reddick. The notch is slight in 71 per cent of 48 specimens of living *C. virginianus* and in two of three specimens of living *C. leucopogon*.

Tibiotarsus.--The posterior margin between the external and internal articular surface is deeply notched in 28 per cent of 18 fossils of *C. suilium* from Arredondo, Orange Lake, and Reddick. The notch is shallow in all specimens of the three living species.

Quantitative Characters

Two types of size trends occur in the genus Colinus. A geographic decrease in size occurs from north to south, with Michigan quail the largest, and southern Florida quail the smallest (Table 8). A temporal decrease in mean size occurs from late Pliocene to the present.

Colinus hibbardi from the upper Pliocene of Kansas is the largest known Colinus, and quail from the Pleistocene of Florida are usually larger than their Recent geographic representatives. Fossils assigned to the species C. suilium from Arredondo, Williston, Orange Lake, and Reddick, Florida, are decidedly larger than quail living in those places today (Table 9). They average as large as or larger than Recent Colinus virginianus from Michigan in most measurements (Arredondo, 19 of 20 measurements; Williston, 11 of 12; Orange Lake, 17 of 17; and Reddick, 16 of 20). A few bones tentatively assigned to C. suilium from Haile II, Oakhurst Quarry, Eichelberger Cave, and Lake Monroe, Florida, are also similar in size to living C. virginianus virginianus from Michigan, and a single bone from Zuber, Florida, tentatively assigned to C. suilium, is similar in size to living C. virginianus virginianus from Illinois.

Fossils assigned to C. virginianus from Kanapaha, Saber-tooth Cave, the Vero strata, and Warren's Cave, Florida, are about the size of their Recent geographic representatives. Bones assigned to C. virginianus from the

Pleistocene of Friesenhahn Cave, Texas, are only slightly larger than Recent bob-whites from northern Florida.

Recent and fossil species of Colinus are inseparable on intermembral and intramembral ratios (Tables 2-6 and 10-13), with the exception of one fossil humerus from Oakhurst Quarry near Ocala, Florida, which is slightly shorter and stouter than in other Recent and fossil Colinus.

CONCLUSIONS

The American quail form a natural group that has undergone an independent evolution in the New World. The following hypothetical outline of the course of events is based upon the osteology of the living species and on the fossil record.

The families of living Galli were differentiated very early in the Tertiary period. Fossils representing the Cracidae (Gallinuloides Eastman; see Tordoff and Macdonald, 1957), the Phasianidae (Palaeortyx Milne-Edwards), and the Tetraonidae (Palaeophasianus Shufeldt) are recorded from the Eocene. The Meleagrididae (Meleagris antiqua Marsh), and the Odontophoridae (indeterminate odontophorid, Tordoff, 1951) are represented by Oligocene fossils.

The hypothetical ancestor of the Odontophoridae must have been very close to the stock from which the pheasants and grouse arose. It probably was in the following stage of skeletal evolution. The size was relatively large, and the rostrum was short and deep. The sternum was characterized by deep notches, long parallel anterior lateral processes, moderately pneumatic sternal plate, and reduced dorsal foramen of the manubrial spine. The coracoid had a ventrally overhanging brachial tuberosity, with the dorsal intermuscular line slightly raised distally, and the ventral intermuscular line encroaching on the sterno-coracoidal process, whose tip was without a terminal knob. The scapular blade was elongate and had the beginning of a dorsal groove. The humerus had a moderately large pneumatic fossa with a reduced inner shelf, and fossa II was still indistinct. The carpometacarpus had a moderately produced pisiform process and a well developed intermetacarpal tubercle that did not reach the level of metacarpal III. The pelvis had a small pneumatic fossa on the anterior portion of the renal depression, and the pectineal process was small. The hypotarsus had only one closed calcaneal canal, and the inner calcaneal ridge was without a distal extension or spur core.

By Oligocene time the two basic types of pelvis had probably become established, since the single known Oligocene fossil already resembled specialized modern forms. By the Miocene fossa II of the humerus was starting to develop, as shown by Miortyx teres. A vestige of the inner shelf of the pneumatic fossa of the humerus was still present in the middle Pliocene Lophortyx shotwelli.

The Odontophoridae are presently at the following stage of evolution. They are generally the smallest of the Galli. The rostrum is relatively short and deep, with this condition reaching its culmination in Rhynchortyx. The sternum is deeply notched, with long, narrow, parallel anterior lateral processes; the pneumaticity of the anterior sternal plate and the dorsal manubrial foramen has been lost. The coracoid has an overhanging ventral portion of the brachial tuberosity and a sharply raised dorsal intermuscular line; with one exception the termination of the ventral intermuscular line of the coracoid has shifted to the tip of the sterno-coracoidal process, which now ends in a terminal knob. The scapular blade is very long and has a deep dorsal groove. The humerus has a large pneumatic fossa, whose inner shelf is completely lost, except in one species of *Odontophorus*; fossa II is well developed in all genera but *Dendrortyx* and *Odontophorus*. The carpometacarpus has a produced pisiform process, and the intermetacarpal tubercle extends to metacarpal III in all but a few individuals of *Cyrtonyx*. The pelvis has lost the pneumatic fossa in the renal depression, and in the *Odontophorus* group the pectineal process is further reduced or even lost. Finally, the hypotarsus has developed a second closed calcaneal canal in most genera.

In the best known genus, *Colinus*, there has been a progressive trend, from late Pliocene time to the present, toward reduction in size and gradual change in qualitative characters. *Colinus hibbardi* from the upper Pliocene of Kansas is the most distinct species of *Colinus* on the basis of its large size and qualitative osteological characters. *Colinus suilium* from the pre-Wicomico Pleistocene of

Florida is somewhat smaller than *C. hibbardi* and has fewer qualitative osteological characters. Fossils of latest Pleistocene age are identical with living *C. virginianus*, except for their slightly larger size. The change from *C. hibbardi* to *C. suilium* apparently took place during the early Pleistocene. The transition from *C. suilium* to *C. virginianus* occurred in Wicomico time and was probably initiated by the change from glacial to interglacial climate.

SUMMARY

The families and subfamilies of the suborder Galli are redefined on the basis of osteological characters. The skeletons of living genera, species, and subspecies of New World quail are described, and osteological criteria are established for the various taxa.

Certain changes are proposed regarding the classification and relationship in the suborder. Within the suborder Galli the families Numididae and Meleagrididae are placed nearer the primitive family Cracidae, and the Tetraonidae are placed in a higher position near the Phasianidae and New World quail. The New World quail are recognized as a separate family, the Odontophoridae, and represent the most specialized birds in the suborder Galli.

The family Odontophoridae is divided into two distinct groups on the basis of pelvic structure. The *Dendrortyx* group contains *Miortyx* of the Miocene, *Neortyx peninsularis* n.g. n.sp. from the Pleistocene, and the living genera *Dendrortyx*, *Philortyx*, *Oreortyx*, *Callipepla*, *Colinus*, and *Lophortyx*. *Dendrortyx* is at once the most primitive and aberrant living genus of American quail and is most closely related to *Philortyx*. *Oreortyx* is a near relative of the *Callipepla*-*Colinus*-*Lophortyx* complex of genera. The genera in the latter complex are so similar that they might be best considered as subgenera.

The *Odontophorus* group contains the living genera *Odontophorus*, *Dactylortyx*, *Cyrtonyx*, and *Rhynchortyx*. *Odontophorus* appears to be the most primitive genus in this group. *Dactylortyx* and *Cyrtonyx* are similar. *Rhynchortyx* is the most aberrant genus of the *Odontophorus* group.

The Miocene species *Cyrtonyx tedfordi* should probably be transferred from the Odontophoridae to the Cracidae.

The study of more than 700 fossils of the genus *Colinus* shows a progressive trend toward reduction in size and gradual change in qualitative characters. The transition from *C. hibbardi* to *C. suilium* took place during the early Pleistocene, and the change from *C. suilium* to *C. virginianus* occurred in Wicomico time.

TABLE 1.--INTERMEMBRAL RATIOS (PER CENT) OF GALLI

Recent species	$\frac{\text{Ulna length}}{\text{Humerus length}}$			$\frac{\text{Carpometacarpus length}}{\text{Ulna length}}$		
CRACIDAE:						
Mitu mitu	106.4		*n* 1	50.1		*n* 1
Crax globulosa	107.0		*n* 1	49.1		*n* 1
Crax rubra	106.5		*n* 1	48.9		*n* 1
NUMIDIDAE:						
Numida meleagris	95.7	(94.8-96.6)	*n* 2	54.1	(54.1-54.1)	*n* 2
Acryllium vulturinum	103.8	(100.2-111.0)	*n* 3	52.1	(47.9-55.0)	*n* 3
MELEAGRIDIDAE:						
Meleagris gallopavo	98.6	(97.2-100.0)	*n* 4	55.6		*n* 1
PHASIANINAE:						
Lophophorus impejanus	96.5		*n* 1	57.0		*n* 1
Gennaeus nycthemerus	98.8		*n* 1	53.5		*n* 1
Gallus gallus	95.7	(95.7-95.7)	*n* 2	55.9	(55.1-56.7)	*n* 2
Catreus wallichii	92.1		*n* 1	55.4		*n* 1
Phasianus colchicus	88.5	(88.0-88.8)	*n* 3	59.1	(57.4-60.0)	*n* 3
Chrysolophus pictus	90.9		*n* 1	57.5		*n* 1
Argusianus argus	103.1		*n* 1	53.3		*n* 1
Pavo cristatus	103.0		*n* 1	51.2		*n* 1
Pavo muticus	93.9	(93.4-94.3)	*n* 2	54.6	(53.4-55.8)	*n* 2
PERDICINAE:						
Alectoris graeca	95.8	(95.6-96.0)	*n* 2	60.7	(59.4-62.0)	*n* 2
Perdix perdix	91.5		*n* 1	61.9		*n* 1
Coturnix coturnix	84.2	(84.1-84.2)	*n* 2	66.9	(65.5-68.3)	*n* 2
TETRAONIDAE:						
Lagopus lagopus	93.2		*n* 1	58.1		*n* 1
Bonasa umbellus	95.3	(95.2-95.4)	*n* 2	61.3	(60.8-61.7)	*n* 2
Pedioecetes phasianellus	92.4		*n* 1	60.6		*n* 1

TABLE 1 (continued)

Recent species	Femur length / Tibiotarsus length			Tarsometatarsus length / Femur length		
CRACIDAE:						
Mitu mitu	68.1		*n* 1	101.7		*n* 1
Crax globulosa	69.0		*n* 1	93.7		*n* 1
Crax rubra	67.2		*n* 1	95.9		*n* 1
NUMIDIDAE:						
Numida meleagris	74.1	(72.6–75.6)	*n* 2	83.4		*n* 2
Acryllium vulturinum	63.4	(62.8–63.8)	*n* 3	111.0	(108.7–114.3)	*n* 3
MELEAGRIDIDAE:						
Meleagris gallopavo	62.6	(58.1–65.2)	*n* 3	109.6		*n* 1
PHASIANINAE:						
Lophophorus impejanus	74.7		*n* 1	75.5		*n* 1
Gennaeus nycthemerus	69.8		*n* 1	100.5		*n* 1
Gallus gallus	72.0	(71.3–72.7)	*n* 2	92.5	(90.9–94.1)	*n* 2
Catreus wallichii	77.2		*n* 1	76.8		*n* 1
Phasianus colchicus	75.6	(74.1–76.7)	*n* 3	86.2	(83.8–88.6)	*n* 2
Argusianus argus	65.6		*n* 1	105.5		*n* 1
Pavo cristatus	62.9		*n* 1	106.3		*n* 1
Pavo muticus	59.4	(57.3–61.5)	*n* 2	114.0	(106.9–121.0)	*n* 2
PERDICINAE:						
Alectoris graeca	73.7	(73.5–73.8)	*n* 2	78.8	(76.8–80.7)	*n* 2
Perdix perdix	78.9		*n* 1	75.2		*n* 1
Coturnix coturnix	80.5	(80.4–80.5)	*n* 2	77.1	(77.0–77.2)	*n* 2
TETRAONIDAE:						
Lagopus lagopus	80.0		*n* 1	65.9		*n* 1
Bonasa umbellus	75.7	(75.3–76.0)	*n* 2	73.9	(73.6–74.2)	*n* 2
Pedioecetes phasianellus	74.8		*n* 1	66.4		*n* 1

TABLE 1 (continued)

Recent species	Tarsometatarsus length / Tibiotarsus length			Ulna length / Femur length		
CRACIDAE						
Mitu mitu	69.2		*n* 1	103.8		*n* 1
Crax globulosa	64.6		*n* 1	108.0		
Crax rubra	64.4		*n* 1	108.3		
NUMIDIDAE:						
Numida meleagris	61.8	(61.1–62.5)	*n* 2	92.3	(91.3–93.3)	*n* 2
Acryllium vulturinum	70.4	(69.1–71.8)	*n* 3	105.6	(103.8–111.4)	*n* 3
MELEAGRIDIDAE:						
Meleagris gallopavo	---	---	---	103.9	(100.6–106.7)	*n* 7
PHASIANINAE:						
Lophophorus impejanus	56.5		*n* 1	88.0		*n* 1
Gennaeus nycthemerus	70.1		*n* 1	82.5		*n* 1
Gallus gallus	66.6	(66.1–67.1)	*n* 2	89.0	(88.0–90.0)	*n* 2
Catreus wallichii	59.3		*n* 1	68.9		*n* 1
Phasianus colchicus	65.1	(64.3–65.8)	*n* 2	80.4	(78.3–84.0)	*n* 3
Chrysolophus pictus	71.8		*n* 1	---	---	---
Argusianus argus	69.3		*n* 1	100.5		*n* 1
Pavo cristatus	66.9		*n* 1	113.9		*n* 1
Pavo muticus	67.6	(65.8–69.3)	*n* 1	107.6	(104.6–110.5)	*n* 1
PERDICINAE:						
Alectoris graeca	58.0	(56.7–59.4)	*n* 2	80.2	(79.8–80.5)	*n* 2
Perdix perdix	59.4		*n* 1	82.5		*n* 1
Coturnix coturnix	62.1	(62.0–62.1)	*n* 2	76.6	(75.8–77.3)	*n* 2
TETRAONIDAE:						
Lagopus lagopus	52.7		*n* 1	93.7		*n* 1
Bonasa umbellus	55.9	(55.8–56.0)	*n* 2	83.5	(82.9–84.1)	*n* 2
Pedioecetes phasanellus	49.7		*n* 1	90.3		*n* 2

TABLE 1 (continued)

Recent species	Ulna length / Tibiotarsus length			Carpometacarpus length / Femur length		
CRACIDAE:						
Mitu mitu	71.0		*n* 1	52.2		*n* 1
Crax globulosa	74.5		*n* 1	53.0		*n* 1
Crax rubra	72.8		*n* 1	52.9		*n* 1
NUMIDIDAE:						
Numida meleagris	68.4	(67.8-69.0)	*n* 2	50.0	(49.4-50.5)	*n* 2
Acryllium vulturinum	67.0	(63.8.71.2)	*n* 3	54.9	(53.4-57.1)	*n* 3
MELEAGRIDIDAE:						
Meleagris gallopavo	65.8	(60.7-69.6)	*n* 3	57.9		*n* 1
PHASIANINAE:						
Lophophorus impejanus	65.9		*n* 1	50.2		*n* 1
Gennaeus nycthemerus	57.6		*n* 1	44.1		*n* 1
Gallus gallus	64.1	(64.0-64.2)	*n* 2	49.8	(49.7-49.9)	*n* 2
Catreus wallichii	53.2		*n* 1	38.2		*n* 1
Phasianus colchicus	60.7	(59.5-62.3)	*n* 3	47.5	(46.8-48.3)	*n* 3
Chrysolophus pictus	48.9		*n* 1	---	---	---
Argusianus argus	65.9		*n* 1	53.5		*n* 1
Pavo cristatus	71.6		*n* 1	58.2		*n* 1
Pavo muticus	63.9	(63.4-64.4)	*n* 2	58.7	(58.4-59.0)	*n* 2
PERDICINAE:						
Alectoris graeca	59.1	(58.9-59.2)	*n* 2	48.6	(47.4-49.8)	*n* 2
Perdix perdix	65.1		*n* 1	51.1		*n* 1
Coturnix coturnix	61.6	(61.0-62.2)	*n* 2	51.3	(49.7-52.8)	*n* 2
TETRAONIDAE:						
Lagopus lagopus	74.9		*n* 1	54.5		*n* 1
Bonasa umbellus	63.2	(62.4-64.0)	*n* 2	51.1	(51.1-51.1)	*n* 2
Pedioecetes phasianellus	67.5		*n* 1	54.7		*n* 1

TABLE 1 (continued)

Recent species	Carpometacarpus length / Tarsometatarsus length			Ilium length / Sternum length		
CRACIDAE:						
Mitu mitu	51.4		*n* 1	114.7		*n* 1
Crax globulosa	56.5		*n* 1	104.2		*n* 1
Crax rubra	55.2		*n* 1	91.6		*n* 1
Ortalis vetula	---		---	104.5	(101.1-109.0)	*n* 3
NUMIDIDAE:						
Numida meleagris	59.9	(59.7-60.0)	*n* 2	89.7		*n* 1
Acryllium vulturinum	49.5	(47.5-52.5)	*n* 3	91.4	(88.0-93.8)	*n* 3
MELEAGRIDIDAE:						
Meleagris gallopavo	---		---	87.0	(85.7-88.3)	*n* 2
PHASIANINAE:						
Lophophorus impejanus	66.4		*n* 1	84.3		*n* 1
Gennaeus nycthemerus	43.9		*n* 1	83.3		*n* 1
Gallus gallus	53.8	(52.8-54.8)	*n* 2	92.0	(88.5-95.4)	*n* 2
Catreus wallichii	49.7		*n* 1	89.9		*n* 1
Phasianus colchicus	55.5	(54.5-56.3)	*n* 2	81.4	(73.4-90.2)	*n* 3
Chrysolophus pictus	39.2		*n* 1	---	---	---
Argusianus angus	50.7		*n* 1	91.3		*n* 1
Pavo cristatus	54.8		*n* 1	84.3		*n* 1
Pavo muticus	51.8	(48.8-54.7)	*n* 2	86.8		*n* 1
PERDICINAE:						
Alectoris graeca	61.7	(61.7-61.7)	*n* 1	92.3	(89.6-94.9)	*n* 2
Perdix perdix	67.8		*n* 1	---	---	---
Coturnix coturnix	66.4	(64.3-68.5)	*n* 2	83.4	(82.5-84.3)	*n* 2
TETRAONIDAE:						
Lagopus lagopus	82.6		*n* 1	75.9		*n* 1
Canachites canadensis	---		---	71.5		*n* 1
Bonasa umbellus	69.2	(68.9-69.4)	*n* 2	74.0	(68.7-79.3)	*n* 1
Pedioecetes phasianellus	82.4		*n* 1	80.2		*n* 1

TABLE 2.--INTERMEMBRAL RATIOS (PER CENT) OF LIVING SPECIES OF QUAIL

Recent species	Ulna length / Humerus length		Ilium length / Sternum length		Carina height / Ilium length	
Dendrortyx						
leucophrys	88.4	n 1	88.6	n 1	34.3	n 1
Philortyx						
fasciatus	87.2	n 1	---	n 3	41.1	n 1
Oreortyx						
picta	93.1 (91.8-94.2)	n 4	67.0 (64.8-68.5)	n 3	45.2 (44.5-46.0)	n 1
Callipepla						
squamata	91.7 (91.5-91.9)	n 4	68.2 (66.3-69.3)	n 4	45.1 (43.0-47.3)	n 4
Colinus						
virginianus	89.0 (86.1-91.4)	n 25	69.3 (66.2-75.3)	n 20	41.7 (36.5-45.2)	n 20
nigrogularis	--- ---	---	69.3	n 1	38.1	n 1
leucopogon	87.8 (87.5-87.9)	n 3	68.8 (67.8-70.0)	n 1	39.6 (37.5-41.2)	n 3
Lophortyx						
californica	86.8 (85.8-87.8)	n 2	68.2 (66.4-70.3)	n 3	43.0 (42.0-44.6)	n 3
gambelli	89.3	n 1	70.4	n 1	43.4	n 1
douglasii	86.6 (86.3-86.9)	n 2	68.8 (68.0-69.6)	n 2	45.0	n 1
Odontophorus						
gujanensis	99.1 (96.3-101.9)	n 2	76.1 (75.9-76.2)	n 2	42.5 (42.1-42.8)	n 2
stellatus	98.3	n 1	74.4	n 1	44.2	n 1
guttatus	97.0	n 1	71.3	n 1	41.3	n 1
Dendrortyx						
thoracidus	98.6 (97.9-99.5)	n 3	73.9 (70.0-77.9)	n 3	43.4 (40.1-48.6)	n 3
Cyrtonyx						
montezumae	93.6 (92.8-94.4)	n 3	74.5 (71.5-76.2)	n 3	39.5 (37.9-41.4)	n 3
Rhynchortyx						
cinctus	101.8	n 1	68.1	n 1	51.7	n 1

TABLE 2 (continued)

Recent species	Tarsometatarsus length / Femur length				Tarsometatarsus length / Tibiotarsus length				Humerus length / Femur length			
Dendrortyx												
leucophrys	87.8		*n*	1	63.0		*n*	1	71.1		*n*	1
Philortyx												
fasciatus	75.9		*n*	1	58.8		*n*	1	81.9		*n*	1
Oreortyx												
picta	79.8	(75.0–82.0)	*n*	4	57.7	(57.5–57.9)	*n*	4	85.7	(82.7–88.6)	*n*	4
Callipepla												
squamata	81.0	(79.1–82.0)	*n*	4	58.8	(58.6–59.0)	*n*	3	87.4	(84.6–88.9)	*n*	4
Colinus												
virginianus	77.9	(73.1–82.8)	*n*	24	58.0	(56.5–60.6)	*n*	26	85.5	(82.4–88.1)	*n*	25
leucopogon	73.6	(73.3–73.8)	*n*	4	56.9	(56.9–56.9)	*n*	2	83.7	(82.3–85.0)	*n*	2
Lophortyx												
californica	78.7	(78.4–78.9)	*n*	2	57.3	(56.8–57.7)	*n*	2	80.1	(79.4–80.7)	*n*	2
gambelii	82.4		*n*	1	59.1		*n*	1	83.2		*n*	1
douglasii	75.7	(75.6–75.8)	*n*	2	57.6	(57.1–58.2)	*n*	2	84.6		*n*	1
Odontophorus												
gujanensis	85.6	(84.6–86.6)	*n*	2	62.9	(62.7–63.0)	*n*	2	84.8	(83.8–85.8)	*n*	2
stellatus	83.5		*n*	1	62.9		*n*	1	84.0		*n*	1
guttatus	86.7		*n*	1	64.6		*n*	1	82.4		*n*	1
Dactylortyx												
thoracicus	81.4	(81.2–81.7)	*n*	3	59.4	(58.7–60.4)	*n*	3	90.5	(90.0–91.0)	*n*	3
Cyrtonyx												
montezumae	71.3	(70.2–73.2)	*n*	3	54.0	(52.6–55.6)	*n*	3	98.0	(95.0–101.0)	*n*	3
Rhynchortyx												
cinctus	88.1		*n*	1	62.7		*n*	1	85.2		*n*	1

TABLE 2 (continued)

Recent species	Humerus length / Tibiotarsus length		Ulna length / Femur length		Ulna length / Tibiotarsus length	
Dendrortyx						
leucophrys	51.0	*n* 1	62.8	*n* 1	45.1	*n* 1
Philortyx						
fasciatus	63.5	*n* 1	71.5	*n* 1	55.4	*n* 1
Oreortyx						
picta	60.1 (58.4–60.9)	*n* 3	79.8 (77.5–82.1)	*n* 4	56.3	*n* 3
Callipepla						
squamata	63.8 (62.7–65.0)	*n* 3	80.1 (77.7–81.5)	*n* 4	58.5 (57.6–59.1)	*n* 3
Colinus						
virginianus	63.8 (61.5–65.6)	*n* 25	75.9 (72.0–78.9)	*n* 25	56.8 (55.3–58.6)	*n* 25
leucopogon	64.8 (64.0–65.6)	*n* 2	73.5 (72.1–74.8)	*n* 2	56.9 (56.0–57.7)	*n* 2
Lophortyx						
californica	58.2 (58.0–58.4)	*n* 2	69.6 (68.2–70.9)	*n* 2	50.6 (50.2–51.0)	*n* 2
gambelii	59.7	*n* 1	74.3	*n* 1	53.3	*n* 1
douglasii	64.4 (63.8–56.0)	*n* 2	73.3 (73.0–73.5)	*n* 1	55.8 (55.1–56.4)	*n* 2
Odontophorus						
gujanensis	62.3 (61.0–63.6)	*n* 2	84.1 (82.7–85.4)	*n* 2	61.7 (61.2–62.2)	*n* 2
stellatus	63.3	*n* 1	82.5	*n* 1	62.2	*n* 1
guttatus	61.4	*n* 1	79.9	*n* 1	59.5	*n* 1
Dendrortyx						
thoracicus	65.1 (65.6–67.0)	*n* 3	89.3 (88.1–90.8)	*n* 3	65.2 (64.6–65.6)	*n* 3
Cyrtonyx						
montezumae	74.1 (72.4–75.3)	*n* 3	91.8 (89.0–93.3)	*n* 3	69.4 (67.8–70.6)	*n* 3
Rhynchortyx						
cinctus	60.1	*n* 1	86.8	*n* 1	61.8	*n* 1

TABLE 2 (continued)

Recent species	Ulna length / Tarsometatarsus			Carpometacarpus / Femur length			Carpometacarpus / Tibiotarsus length		
Dendrortyx									
leucophrys	71.6		*n* 1	37.0		*n* 1	26.6		*n* 1
Philortyx									
fasciatus	94.2		*n* 1	43.9		*n* 1	34.0		*n* 1
Oreortyx									
picta	100.3	(94.5–109.5)	*n* 4	48.5	(47.0–49.8)	*n* 4	34.3	(33.2–35.1)	*n* 3
Callipepla									
squamata	98.9	(95.8–102.1)	*n* 4	47.7	(47.0–48.1)	*n* 4	34.6	(34.1–35.1)	*n* 3
Colinus									
virginianus	97.9	(91.7–103.1)	*n* 24	45.5	(42.7–47.2)	*n* 25	33.9	(32.7–35.3)	*n* 27
leucopogon	101.3	(98.4–104.0)	*n* 2	44.0	(42.9–45.0)	*n* 2	34.1	(33.4–34.7)	*n* 2
Lophortyx									
californica	88.4	(86.9–89.8)	*n* 2	39.5	(36.9–42.1)	*n* 2	31.4	(31.0–31.8)	*n* 2
gambelii	90.1		*n* 1	44.8		*n* 1	32.1		*n* 1
douglasii	96.8	(96.6–97.0)	*n* 2	44.6	(44.6–44.6)	*n* 2	34.2	(33.7–34.6)	*n* 2
Odontophorus									
gujanensis	98.2	(97.7–98.6)	*n* 2	48.2	(47.3–49.0)	*n* 2	33.5	(34.5–36.3)	*n* 2
stellatus	98.8		*n* 1	47.7		*n* 1	36.0		*n* 1
guttatus	92.1		*n* 1	44.5		*n* 1	33.1		*n* 1
Dactylortyx									
thoracicus	109.7	(108.5–111.2)	*n* 3	49.1	(48.1–50.3)	*n* 3	35.8	(35.4–36.2)	*n* 3
Cyrtonyx									
montezumae	128.7	(126.4–132.7)	*n* 3	51.3	(49.7–52.1)	*n* 3	38.8	(37.9–39.5)	*n* 3
Rhynchortyx									
cinctus	98.5		*n* 1	48.3		*n* 1	34.4		*n* 1

TABLE 2 (continued)

Recent species	Carpometacarpus / Tarsometatarsus			Tarsometatarsus / Humerus length			Wing / Leg		
Dendrortyx									
leucophrys	42.2		*n* 1	123.5		*n* 1	52.3		*n* 1
Philortyx									
fasciatus	57.8		*n* 1	92.6		*n* 1	64.7		*n* 1
Oreortyx									
picta	61.0	(57.3–65.5)	*n* 4	93.1	(84.6–99.1)	*n* 4	65.6	(64.0–66.6)	*n* 3
Callipepla									
squamata	58.8	(57.8–60.6)	*n* 4	92.8	(88.9–96.0)	*n* 4	68.0	(67.1–68.9)	*n* 3
Colinus									
virginianus	58.4	(55.4–61.6)	*n* 26	91.1	(85.5–98.1)	*n* 25	66.3	(62.8–68.5)	*n* 22
leucopogon	60.0	(58.6–61.0)	*n* 3	86.7	(84.5–88.9)	*n* 3	66.5	(65.4–67.5)	*n* 2
Lophortyx									
californica	54.9	(53.7–56.0)	*n* 2	98.3	(97.8–98.7)	*n* 2	61.0	(60.4–61.6)	*n* 2
gambelii	54.4		*n* 1	99.1		*n* 1	62.8		*n* 1
douglasii	59.3	(59.0–59.5)	*n* 2	89.4	(89.2–89.6)	*n* 2	66.0	(65.7–66.4)	*n* 2
Odontophorus									
gujanensis	56.3	(54.6–57.9)	*n* 2	100.1	(98.6–103.3)	*n* 2	67.4	(66.8–68.0)	*n* 2
stellatus	57.1		*n* 1	99.5		*n* 1	67.7		*n* 1
guttatus	51.3		*n* 1	105.3		*n* 1	64.4		*n* 1
Dactylortyx									
thoracicus	60.3	(59.3–61.6)	*n* 3	89.9	(89.5–90.2)	*n* 3	71.9	(71.5–72.5)	*n* 3
Cyrtonyx									
montezumae	71.9	(70.6–74.0)	*n* 3	72.8	(70.0–74.4)	*n* 3	79.4	(77.5–80.9)	*n* 3
Rhynchortyx									
cincta	54.8		*n* 1	103.3		*n* 1	67.1		*n* 1

TABLE 3.--RATIOS (PER CENT) OF STERNUM, PELVIS, AND SYNSACRUM IN LIVING QUAIL

Recent species	Height of carina / Length of sternum		Width through antitrochanters / Length of Innominates		Length, first through fourth vertebra / Width, through fourth verbetra	
Dendrortyx						
leucophrys	30.4	n 1	51.2	n 1	55.2	n 1
Philortyx						
fasciatus	---	---	47.3	n 1	59.5	n 1
Oreortyx						
picta	30.3 (29.3-31.1)	n 3	61.8 (60.0-63.0)	n 3	73.9 (67.4-84.8)	n 4
Callipepla						
squamata	30.7 (29.6-31.3)	n 4	60.0 (58.2-62.3)	n 4	73.9 (71.0-79.6)	n 4
Colinus						
virginianus	28.8 (25.4-32.2)	n 20	47.5 (44.3-49.5)	n 12	61.1 (57.0-67.5)	n 20
nigrogularis	27.8	n 1	48.0 (45.0-51.0)	n 2	63.7 (62.1-65.3)	n 2
leucopogon	27.3 (25.4-28.9)	n 3	49.7 (48.9-50.5)	n 2	62.4 (58.4-66.4)	n 2
Lophortyx						
californica	29.4 (28.3-31.4)	n 3	55.4 (54.1-56.7)	n 2	69.6 (66.7-74.2)	n 3
gambelii	30.6	n 1	55.3	n 1	74.8	n 1
douglasii	31.3	n 1	54.9 (54.6-55.1)	n 2	72.6 (67.7-75.5)	n 2
Odontophorus						
gujanensis	32.3 (32.1-32.5)	n 1	50.5	n 1	75.1 (71.3-78.8)	n 2
stellatus	32.9	n 1	51.0	n 1	72.0	n 1
guttatus	29.4	n 1	52.6	n 1	72.9	n 1
Dactylortyx						
thoracicus	32.7 (30.7-34.1)	n 3	56.0 (55.1-57.6)	n 3	90.7 (88.1-93.2)	n 3
Cyrtonyx						
montezumae	29.4 (28.0-31.5)	n 3	51.8 (50.0-54.2)	n 3	69.0 (66.7-70.7)	n 3
Rhynchortyx						
cinctus	35.2	n 1	59.3	n 1	92.3	n 1

TABLE 4.--RATIOS (PER CENT) OF ULNA AND TIBIOTARSUS IN LIVING QUAIL

Recent species	$\frac{\text{Height middle of ulnar shaft}}{\text{Height distal to external cotyla}}$		$\frac{\text{Depth inner cnemial crest}}{\text{Length inner cnemial crest}}$	
Dendrortyx leucophrys	82.5	*n* 1	58.5	*n* 1
Philortyx fasciatus	84.8	*n* 1	44.7	*n* 1
Oreortyx picta	65.7 (63.8–69.8)	*n* 4	68.4 (64.8–73.8)	*n* 3
Callipepla squamata	64.7 (62.7–65.9)	*n* 4	69.6 (64.2–72.7)	*n* 3
Colinus				
virginianus	66.6 (61.5–71.4)	*n* 20	63.9 (53.9–69.2)	*n* 20
leucopogon	67.8 (64.3–70.6)	*n* 3	60.0 (60.0–6.0)	*n* 2
Lophortyx				
californica	67.0 (66.6–67.4)	*n* 2	60.0 (57.5–62.5)	*n* 2
gambelii	61.0	*n* 1	67.1	*n* 1
douglasii	71.2 (70.3–72.2)	*n* 2	66.7 (66.2–67.1)	*n* 2
Odontophorus				
gujanensis	72.0	*n* 1	58.2	*n* 1
stellatus	65.2	*n* 1	64.8	*n* 1
guttatus	68.0	*n* 1	68.2	*n* 1
Dactylortyx thoracicus	71.2 (71.1–71.4)	*n* 3	43.8 (41.7–47.8)	*n* 3
Cyrtonyx montezumae	61.6 (60.0–62.5)	*n* 3	39.9 (36.7–45.7)	*n* 3
Rhynchortyx cinctus	60.9	*n* 1	74.5	*n* 1

TABLE 5.--RATIOS (PER CENT) OF FEMUR IN LIVING QUAIL

Recent species	Distal width / Femur length			Trochanteric ridge length / Femur length			Distal depth / Distal width		
Dendrortyx									
leucophrys	16.9		*n* 1	22.4		*n* 1	84.7		*n* 1
Philortyx									
fasciatus	14.3		*n* 1	26.6		*n* 1	96.6		*n* 1
Oreortyx									
picta	16.9	(16.6-17.3)	*n* 4	24.0	(23.2-24.8)	*n* 4	79.6	(75.6-82.7)	*n* 4
Callipepla									
squamata	17.4	(17.0-17.8)	*n* 4	23.9	(23.6-24.1)	*n* 4	78.1	(75.7-82.1)	*n* 4
Colinus									
virginianus	16.2	(15.3-17.6)	*n* 20	22.7	(20.9-24.2)	*n* 20	84.4	(77.5-89.6)	*n* 20
nigrogularis	16.3	(16.0-16.6)	*n* 2	23.7	(22.8-24.5)	*n* 2	82.9	(80.6-85.1)	*n* 2
leucopogon	16.1	(15.5-16.7)	*n* 2	23.2	(23.0-23.3)	*n* 2	86.3	(82.5-90.0)	*n* 2
Lophortyx									
californica	17.4	(17.2-17.6)	*n* 2	24.8	(24.5-25.1)	*n* 2	82.6	(81.9-83.3)	*n* 2
gambelii	17.9		*n* 1	23.8		*n* 1	77.8		*n* 1
douglasii	17.2	(16.8-17.6)	*n* 2	24.6	(24.6-24.6)	*n* 2	81.1	(77.1-85.1)	*n* 2
Odontophorus									
gujanensis	18.4	(18.1-18.7)	*n* 2	23.9	(21.9-25.9)	*n* 2	83.3	(83.2-83.3)	*n* 1
stellatus	17.3		*n* 1	21.8		*n* 1	84.7		*n* 1
guttatus	16.5		*n* 1	20.5		*n* 1	84.9		*n* 3
Dactylortyx									
thoracicus	18.9	(18.6-19.1)	*n* 3	16.5	(14.6-17.9)	*n* 3	82.4	(80.7-83.7)	*n* 3
Cyrtonyx									
montezumae	17.8	(17.3-18.5)	*n* 3	24.3	(22.8-25.2)	*n* 3	76.9	(75.3-78.5)	*n* 1
Rhynchortyx									
cinctus	17.6		*n* 1	11.7		*n* 1	70.5		*n* 1

TABLE 6.--RATIOS (PER CENT) OF TARSOMETATARSUS IN LIVING QUAIL

Recent species	Distal width / Length			Proximal depth / Proximal width			Middle trochlea depth / Distal width		
Dendrortyx									
leucophrys	14.1		*n* 1	93.8		*n* 1	56.0		*n* 1
Philortyx									
fasciatus	17.0		*n* 1	86.4		*n* 1	58.5		*n* 1
Oreortyx									
picta	17.6	(17.0-18.0)	*n* 4	95.3	(90.9-98.4)	*n* 4	51.4	(50.0-53.1)	*n* 4
Callipepla									
squamata	17.3	(15.4-18.2)	*n* 4	97.0	(95.0-98.2)	*n* 4	54.5	(51.7-58.5)	*n* 4
Colinus									
virginianus	17.2	(16.1-18.8)	*n* 20	96.3	(92.7-100.0)	*n* 20	54.4	(51.7-59.6)	*n* 20
leucopogon	17.8	(16.9-18.3)	*n* 3	96.9	(92.6-100.0)	*n* 3	53.8	(53.7-54.0)	*n* 3
Lophortyx									
californica	18.3	(18.2-18.4)	*n* 2	95.8	(93.2-98.3)	*n* 2	55.0	(53.3-56.7)	*n* 2
gambelii	17.8		*n* 1	96.6		*n* 1	52.5		*n* 1
douglasii	19.1	(18.7-19.5)	*n* 2	100.0	(100.0-100.0)	*n* 2	52.2	(50.8-53.6)	*n* 2
Odontophorus									
gujanensis	17.0	(16.5-17.4)	*n* 2	100.0	(100.0-100.0)	*n* 2	57.7	(54.7-60.6)	*n* 2
stellatus	17.6		*n* 1	95.9		*n* 1	54.2		*n* 1
guttatus	16.6		*n* 1	98.6		*n* 1	54.2		*n* 1
Dactylortyx									
thoracicus	20.3	(19.3-20.9)	*n* 3	91.7	(88.2-94.0)	*n* 3	48.4	(45.3-50.0)	*n* 3
Cyrtonyx									
montezumae	21.3	(20.8-22.1)	*n* 3	96.6	(95.0-98.2)	*n* 2	46.3	(45.5-47.5)	*n* 3
Rhynchortyx									
cinctus	16.4		*n* 1	94.7		*n* 1	56.2		*n* 1

TABLE 7.--MEASUREMENTS (IN MM.) OF LIVING SPECIES OF QUAIL

Recent species	Length of coracoid			Proximal width of coracoid			Distal width of coracoid		
Dendrortyx									
leucophrys	33.10		*n* 1	4.90		*n* 1	9.60		*n* 1
Philortyx									
fasciatus	28.00		*n* 1	3.90		*n* 1	8.10		*n* 1
Oreortyx									
picta	31.78	(31.0-32.3)	*n* 4	4.93	(4.6-5.4)	*n* 4	10.40	(9.8-11.2)	*n* 4
Callipepla									
squamata	28.88	(27.6-30.2)	*n* 4	4.53	(4.4-4.9)	*n* 4	9.65	(8.9-10.4)	*n* 4
Colinus									
virginianus	28.68	(25.7-30.9)	*n* 95	4.16	(3.6-4.9)	*n* 97	8.58	(7.2-9.9)	*n* 95
nigrogularis	25.70	(25.5-25.9)	*n* 2	3.70	(3.7-3.7)	*n* 2	7.45	(7.4-7.5)	*n* 2
leucopogon	27.77	(26.9-28.9)	*n* 3	3.83	(3.4-4.2)	*n* 3	7.90	(7.8-8.0)	*n* 3
Lophortyx									
californica	29.33	(28.6-30.3)	*n* 3	4.50	(4.5-4.5)	*n* 3	9.03	(8.6-9.4)	*n* 3
gambelii	27.90		*n* 1	4.50		*n* 1	8.40		*n* 1
douglasii	27.65	(27.5-27.8)	*n* 2	4.35	(4.1-4.6)	*n* 2	7.80	(7.5.8.1)	*n* 2
Odontophorus									
gujanensis	37.20	(36.9-37.5)	*n* 2	5.05	(5.0-5.1)	*n* 2	10.75	(10.5-11.0)	*n* 2
stellatus	33.90		*n* 1	5.20		*n* 1	9.60		*n* 1
guttatus	35.40		*n* 1	4.90		*n* 1	9.80		*n* 1
Dactylortyx									
thoracicus	31.30	(31.0-31.7)	*n* 3	4.80	(4.6-5.0)	*n* 3	10.20	(10.0-10.5)	*n* 3
Cyrtonyx									
montezumae	30.57	(29.8-31.3)	*n* 3	4.36	(4.2-4.6)	*n* 3	10.00	(9.5-10.5)	*n* 3
Rhynchortyx									
cinctus	29.00		*n* 1	4.00		*n* 1	9.00		*n* 1

TABLE 7 (continued)

Recent species	Proximal width of scapula			Width of shaft of scapula			Length of humerus		
Dendrortyx									
leucophrys	7.30		*n* 1	3.10		*n* 1	41.30		*n* 1
Philortyx									
fasciatus	6.80		*n* 1	2.40		*n* 1	33.60		*n* 1
Oreortyx									
picta	7.65	(7.3-8.1)	*n* 4	3.38	(3.1-3.7)	*n* 4	38.42	(36.8-39.7)	*n* 4
Callipepla									
squamata	6.80	(6.6-7.0)	*n* 4	2.85	(2.7-3.0)	*n* 4	35.85	(34.6-37.1)	*n* 4
Colinus									
virginianus	6.70	(5.7-7.4)	*n* 99	2.62	(2.2-3.0)	*n* 97	35.03	(32.0-37.7)	*n* 84
nigrogularis	6.05	(6.0-6.1)	*n* 2	2.15	(2.1-2.2)	*n* 2	---	---	---
leucopogon	6.33	(6.1-6.6)	*n* 3	2.47	(2.2-2.8)	*n* 3	33.60	(32.3-34.5)	*n* 3
Lophortyx									
californica	6.90	(6.8-7.0)	*n* 2	2.80	(2.6-3.0)	*n* 2	32.90	(32.5-33.2)	*n* 3
gambelii	7.20		*n* 1	2.60		*n* 1	33.60		*n* 1
douglasii	6.85	(6.8-6.9)	*n* 2	2.60	(2.5-2.7)	*n* 2	33.60	(33.6-33.6)	*n* 2
Odontophorus									
gujanensis	8.55	(8.5-8.6)	*n* 2	3.25	(3.0-3.5)	*n* 2	42.70	(41.8-43.6)	*n* 2
stellatus	7.70		*n* 1	2.90		*n* 1	40.80		*n* 1
guttatus	8.20		*n* 1	3.00		*n* 1	43.50		*n* 1
Dactylortyx									
thoracicus	7.70	(7.5-8.0)	*n* 3	3.07	(3.0-3.2)	*n* 3	38.43	(36.7-39.9)	*n* 3
Cyrtonyx									
montezumae	7.00	(6.6-6.3)	*n* 3	2.77	(2.7-2.9)	*n* 3	40.50	(39.9-41.4)	*n* 3
Rhynchortyx									
cinctus	6.20		*n* 1	2.70		*n* 1	33.00		*n* 1

TABLE 7 (continued)

Recent species	Proximal width of humerus			Mid-shaft of humerus			Distal width of humerus		
Dendrortyx									
leucophrys	10.50		n 1	4.10		n 1	8.40		n 1
Philortyx									
fasciatus	9.00		n 1	3.30		n 1	6.70		n 1
Oreortyx									
picta	11.05	(11.0-11.1)	n 4	4.13	(4.0-4.4)	n 4	8.18	(8.0-8.5)	n 4
Callipepla									
squamata	9.65	(9.6-9.7)	n 4	3.43	(3.2-3.6)	n 4	7.38	(7.2-7.5)	n 4
Colinus									
virginianus	9.32	(8.5-10.2)	n 94	3.40	(2.7-3.8)	n 89	6.97	(6.2-7.6)	n 88
nigrogularis	8.00		n 1	---	---	---	---	---	---
leucopogon	9.00	(8.5-9.3)	n 3	3.23	(3.1-3.4)	n 3	6.83	(6.5-7.1)	n 3
Lophortyx									
californica	9.47	(9.0-9.8)	n 3	3.53	(3.5-3.6)	n 3	7.20	(7.0-7.4)	n 3
gambelii	9.20		n 1	3.40		n 1	7.20		n 1
douglasii	9.05	(8.9-9.2)	n 2	3.35	(3.2-3.5)	n 2	7.00	(7.0-7.0)	n 2
Odontophorus									
gujanensis	12.55	(12.2-12.9)	n 2	5.10	(4.9-5.3)	n 2	9.50		n 1
stellatus	11.30		n 1	4.60		n 1	9.30		n 1
guttatus	11.90		n 1	4.60		n 1	9.30		n 1
Dactylortyx									
thoracicus	10.83	(10.5-11.2)	n 3	3.97	(3.8-4.2)	n 3	8.37	(8.2-8.5)	n 3
Cyrtonyx									
montezumae	10.27	(10.0-10.5)	n 3	3.63	(3.6-3.7)	n 3	7.90	(7.7-8.2)	n 3
Rhynchortyx									
cinctus	9.80		n 1	3.60		n 1	7.40		n 1

TABLE 7 (continued)

Recent species	Length of ulna			Proximal width of ulna			Mid-shaft of ulna		
Dendrortyx									
leucophrys	36.50		*n* 1	7.10		*n* 1	3.20		*n* 1
Philortyx									
fasciatus	28.00		*n* 1	5.70		*n* 1	2.60		*n* 1
Oreortyx									
picta	35.78	(34.5–36.8)	*n* 4	6.75	(6.0–7.0)	*n* 4	2.98	(2.9–3.0)	*n* 4
Callipepla									
squamata	32.85	(32.2–33.7)	*n* 4	6.13	(6.0–6.2)	*n* 4	2.53	(2.3–2.8)	*n* 4
Colinus									
virginianus	31.15	(28.4–34.0)	*n* 57	5.74	(5.0–6.4)	*n* 69	2.61	(2.1–3.1)	*n* 59
leucopogon	29.50	(28.4–30.2)	*n* 3	5.70	(5.4–5.9)	*n* 3	2.53	(2.4–2.7)	*n* 3
Lophortyx									
californica	28.75	(28.5–39.0)	*n* 2	6.00	(5.9–6.1)	*n* 2	2.70	(2.6–2.8)	*n* 2
gambelii	30.00		*n* 1	5.80		*n* 1	2.50		*n* 1
douglasii	29.10	(29.0–29.2)	*n* 2	5.45	(5.4–5.5)	*n* 2	2.30	(2.2–2.4)	*n* 1
Odontophorus									
gujanensis	42.70		*n* 1	8.00		*n* 1	3.70		*n* 1
stellatus	40.20		*n* 1	7.20		*n* 1	3.10		*n* 1
guttatus	42.20		*n* 1	8.00		*n* 1	3.50		*n* 1
Dactylortyx									
thoracicus	37.90	(36.1–39.7)	*n* 3	6.83	(6.5–7.1)	*n* 3	2.93	(2.8–3.2)	*n* 3
Cyrtonyx									
montezumae	37.93	(37.3–39.1)	*n* 3	6.43	(6.2–6.6)	*n* 3	2.87	(2.7–3.1)	*n* 3
Rhynchortyx									
cinctus	33.60		*n* 1	5.90		*n* 1	2.50		*n* 1

TABLE 7 (continued)

Recent species	Distal width of ulna			Length of carpometacarpus			Proximal height of carpometacarpus		
Dendrortyx									
leucophrys	5.60		*n* 1	21.50		*n* 1	6.50		*n* 1
Philortyx									
fasciatus	4.50		*n* 1	18.00		*n* 1	5.40		*n* 1
Oreortyx									
picta	5.78	(5.5–6.6)	*n* 4	21.75	(20.9–22.5)	*n* 4	6.33	(5.9–6.6)	*n* 4
Callipepla									
squamata	5.00	(5.0–5.0)	*n* 4	19.55	(19.0–20.0)	*n* 4	5.65	(5.5–5.8)	*n* 4
Colinus									
virginianus	4.72	(4.1–5.3)	*n* 57	18.65	(17.0–21.2)	*n* 66	5.38	(4.7–6.2)	*n* 63
leucopogon	4.63	(4.4–4.9)	*n* 3	17.50	(16.5–18.0)	*n* 3	5.17	(5.0–5.4)	*n* 3
Lophortyx									
californica	4.85	(4.7–5.0)	*n* 2	17.85	(17.6–18.1)	*n* 2	5.65	(5.5–5.8)	*n* 2
gambelii	4.90		*n* 1	18.10		*n* 1	5.30		*n* 1
douglasii	4.65	(4.6–4.7)	*n* 2	17.80	(17.7–17.9)	*n* 2	5.20	(5.2–5.2)	*n* 2
Odontophorus									
gujanensis	6.30		*n* 1	24.25	(23.2–25.3)	*n* 2	7.05	(7.0–7.1)	*n* 2
stellatus	6.00		*n* 1	23.10		*n* 1	7.10		*n* 1
guttatus	6.00		*n* 1	23.10		*n* 1	7.10		*n* 1
Dactylortyx									
thoracicus	5.57	(5.5–5.7)	*n* 3	20.83	(19.8–22.0)	*n* 3	6.63	(6.4–6.8)	*n* 3
Cyrtonyx									
montezumae	5.00	(4.9–5.2)	*n* 3	21.20	(20.8–21.9)	*n* 3	5.97	(5.8–6.2)	*n* 3
Rhynchortyx									
cinctus	5.00		*n* 1	18.70		*n* 1	5.90		*n* 1

TABLE 7 (continued)

Recent species	Distal height of carpometacarpus			Length through first four synsacral vertebrae			Length of femur		
Dendrortyx									
leucophrys	5.00		n 1	17.60		n 1	53.00		n 1
Philortyx									
fasciatus	4.50		n 1	11.80		n 1	41.00		n 1
Oreortyx									
picta	5.40	(4.9-6.0)	n 4	12.88	(11.9-13.5)	n 4	44.83	(44.0-45.2)	n 4
Callipepla									
squamata	4.58	(4.4-4.9)	n 4	11.58	(11.0-12.2)	n 4	41.03	(39.5-42.0)	n 4
Colinus									
virginianus	4.45	(3.9.5.4)	n 57	12.33	(10.6-13.8)	n 92	41.02	(37.7-45.7)	n 94
nigrogularis	---	---	---	10.80	(10.2-11.4)	n 2	37.65	(37.6-37.7)	n 2
leucopogon	4.40	(4.1-4.9)	n 3	12.00	(11.0-12.8)	n 3	40.95	(40.0-41.9)	n 2
Lophortyx									
californica	4.80	(4.7-4.9)	n 2	12.10	(11.7-12.6)	n 3	41.35	(40.9-41.8)	n 2
gambelii	4.00		n 1	12.30		n 1	40.40		n 1
douglasii	4.55	(4.5-4.6)	n 2	11.15	(10.9-11.4)	n 2	39.70	(39.7-39.7)	n 2
Odontophorus									
gujanensis	5.40	(5.4-5.4)	n 2	14.10	(14.0-14.2)	n 2	50.35	(49.9-50.8)	n 2
stellatus	5.40		n 1	16.10		n 1	48.60		n 1
guttatus	5.20		n 1	14.80		n 1	52.80		n 1
Dactylortyx									
thoracicus	5.00	(4.6-5.4)	n 3	11.30	(10.8-12.2)	n 3	42.43	(40.7-43.8)	n 3
Cyrtonyx									
montezumae	4.77	(4.5-5.0)	n 3	12.23	(11.9-12.6)	n 3	41.37	(40.0-42.1)	n 3
Rhynchortyx									
cinctus	4.50		n 1	10.50		n 1	38.50		n 1

TABLE 7 (continued)

Recent species	Proximal width of femur		Mid-shaft of femur		Distal width of femur	
Dendrortyx						
leucophrys	10.50	*n* 1	4.50	*n* 1	9.70	*n* 1
Philortyx						
fasciatus	7.30	*n* 1	3.20	*n* 1	6.70	*n* 1
Oreortyx						
picta	8.08 (7.6-8.3)	*n* 4	3.38 (3.3-3.5)	*n* 4	7.70 (7.6-7.8)	*n* 4
Callipepla						
squamata	7.55 (7.3-7.8)	*n* 4	3.00 (2.8-3.1)	*n* 4	7.25 (6.7-7.5)	*n* 4
Colinus						
virginianus	7.17 (6.4-8.1)	*n* 97	2.93 (2.4-3.3)	*n* 96	6.70 (6.0-7.6)	*n* 97
nigrogularis	6.65 (6.5-6.8)	*n* 2	2.65 (2.6-2.7)	*n* 2	6.10 (5.9-6.3)	*n* 2
leucopogon	7.07 (6.5-7.8)	*n* 3	2.93 (2.9-3.0)	*n* 3	6.75 (6.7-6.8)	*n* 2
Lophortyx						
californica	7.60 (7.6-7.6)	*n* 2	3.25 (3.0-3.5)	*n* 2	7.30 (7.2-7.4)	*n* 2
gambelii	7.40	*n* 1	3.10	*n* 1	7.20	*n* 1
douglasii	7.15 (7.1-7.2)	*n* 1	2.90 (2.9-2.9)	*n* 2	6.90 (6.9-6.9)	*n* 2
Odontophorus						
gujanensis	9.55 (9.3-9.8)	*n* 2	3.70 (3.6-3.8)	*n* 2	8.80	*n* 1
stellatus	9.10	*n* 1	3.50	*n* 1	8.40	*n* 1
guttatus	9.00	*n* 1	3.60	*n* 1	8.70	*n* 1
Dactylortyx						
thoracicus	7.90 (7.7-8.2)	*n* 3	3.27 (3.1-3.4)	*n* 3	7.93 (7.6-8.2)	*n* 3
Cyrtonyx						
montezumae	7.43 (7.1-7.8)	*n* 3	3.03 (3.0-3.1)	*n* 3	7.43 (7.1-7.7)	*n* 3
Rhynchortyx						
cinctus	7.00	*n* 1	2.90	*n* 1	6.70	*n* 1

TABLE 7 (continued)

Recent species	Length of tibiotarsus			Proximal width of tibiotarsus			Mid-shaft width of tibiotarsus		
Dendrortyx									
leucophrys	80.90		*n* 1	12.80		*n* 1	3.90		*n* 1
Philortyx									
fasciatus	52.90		*n* 1	8.20		*n* 1	2.90		*n* 1
Oreortyx									
picta	63.30	(62.6-64.0)	*n* 3	10.13	(10.0-10.3)	*n* 4	3.18	(3.1-3.3)	*n* 4
Callipepla									
squamata	56.80	(54.9-58.5)	*n* 4	9.45	(9.1-9.6)	*n* 4	3.08	(2.9-3.2)	*n* 4
Colinus									
virginianus	55.15	(49.7-60.9)	*n* 84	8.78	(8.0-9.7)	*n* 93	2.79	(2.5-3.1)	*n* 91
leucopogon	52.85	(51.8-53.9)	*n* 2	8.37	(7.8-8.7)	*n* 3	2.60	(2.3-2.7)	*n* 2
Lophortyx									
californica	56.85	(56.8-56.9)	*n* 2	9.45	(9.4-9.5)	*n* 2	2.95	(2.7-3.2)	*n* 2
gambelii	56.30		*n* 1	9.10		*n* 1	2.90		*n* 1
douglasii	52.12	(51.7-52.6)	*n* 2	8.85	(8.8-8.9)	*n* 2	2.75	(2.7-2.8)	*n* 2
Odontophorus									
gujanensis	68.55	(68.5-68.6)	*n* 2	11.65	(11.4-11.9)	*n* 2	3.80	(3.8-3.8)	*n* 2
stellatus	64.50		*n* 1	11.40		*n* 1	3.30		*n* 1
guttatus	70.90		*n* 1	11.50		*n* 1	3.60		*n* 1
Dactylortyx									
thoracicus	58.17	(55.9-60.8)	*n* 3	10.90	(10.4-11.3)	*n* 3	3.20	(3.1-3.3)	*n* 3
Cyrtonyx									
montezumae	54.63	(53.4-55.4)	*n* 3	9.53	(9.0-10.0)	*n* 3	3.17	(3.1-3.2)	*n* 3
Rhynchortyx									
cinctus	54.40		*n* 1	7.30		*n* 1	2.50		*n* 1

TABLE 7 (continued)

Recent species	Distal width of tibiotarsus		Length of tarsometatarsus		Proximal width of tarsometatarsus	
Dendrortyx						
leucophrys	7.50	*n* 1	80.90	*n* 1	7.80	*n* 1
Philortyx						
fasciatus	5.30	*n* 1	52.90	*n* 1	5.80	*n* 1
Oreortyx						
picta	5.67 (5.5–6.0)	*n* 3	63.30 (62.6–64.0)	*n* 3	6.38 (6.2–6.6)	*n* 4
Callipepla						
squamata	5.30 (5.1–5.5)	*n* 4	56.80 (54.9–58.5)	*n* 4	5.68 (5.5–5.9)	*n* 4
Colinus						
virginianus	5.16 (4.4–5.8)	*n* 93	55.15 (49.7–60.9)	*n* 84	5.61 (5.0–6.3)	*n* 91
leucopogon	4.93 (4.9–5.0)	*n* 3	52.85 (51.8–53.9)	*n* 2	5.40 (5.4–5.4)	*n* 3
Lophortyx						
californica	5.35 (5.3–5.4)	*n* 2	56.85 (56.8–56.9)	*n* 2	5.90 (5.8–6.0)	*n* 2
gambelii	5.60	*n* 1	56.30	*n* 1	5.90	*n* 1
douglasii	5.05 (5.0–5.1)	*n* 2	52.12 (51.7–52.6)	*n* 2	5.55 (5.5–5.6)	*n* 2
Odontophorus						
gujanensis	6.85 (6.7–7.0)	*n* 2	68.55 (68.5–68.6)	*n* 2	7.40 (7.4–7.4)	*n* 2
stellatus	6.50	*n* 1	64.50	*n* 1	7.30	*n* 1
guttatus	6.70	*n* 1	70.90	*n* 1	7.30	*n* 1
Dactylortyx						
thoracicus	5.93 (5.7–6.1)	*n* 2	58.17 (55.9–60.8)	*n* 3	6.83 (6.7–7.0)	*n* 3
Cyrtonyx						
montezumae	5.53 (5.3–5.7)	*n* 3	54.63 (53.4–55.4)	*n* 3	5.80 (5.7–6.0)	*n* 3
Rhynchortyx						
cinctus	5.00	*n* 1	54.40	*n* 1	5.60	*n* 1

TABLE 7 (continued)

Recent species	Mid-shaft width of tarsometatarsus			Width through trochleae of tarsometatarsus		
Dendrortyx						
leucophrys	3.60		*n* 1	7.20		*n* 1
Philortyx						
fasciatus	3.10		*n* 1	5.30		*n* 1
Oreortyx						
picta	2.80	(2.7-2.9)	*n* 4	6.33	(6.2-6.6)	*n* 4
Callipepla						
squamata	2.70	(2.5-2.8)	*n* 4	5.75	(5.3-6.0)	*n* 4
Colinus						
virginianus	2.65	(2.4-3.1)	*n* 89	5.52	(5.0-6.3)	*n* 89
leucopogon	2.73	(2.6-2.8)	*n* 3	5.20	(4.9-5.5)	*n* 3
Lophortyx						
californica	2.80	(2.7-2.9)	*n* 2	6.05	(6.0-6.1)	*n* 2
gambelii	2.50		*n* 1	5.80		*n* 1
douglasii	2.65	(2.5-2.8)	*n* 2	5.70	(5.4-6.0)	*n* 2
Odontophorus						
gujanensis	3.60	(3.5-3.7)	*n* 2	7.10	(7.1-7.1)	*n* 2
stellatus	3.30		*n* 1	7.10		*n* 2
guttatus	3.50		*n* 1	7.10		*n* 1
Dactylortyx						
thoracicus	3.13	(3.1-3.2)	*n* 3	7.00	(6.8-7.3)	*n* 3
Cyrtonyx						
montezumae	2.80	(2.7-3.0)	*n* 3	6.27	(6.2-6.4)	*n* 3
Rhynchortyx						
cinctus	2.80		*n* 1	5.00		*n* 1

TABLE 8.—SUBSPECIFIC VARIATION (MM.) IN *COLINUS VIRGINIANUS*

Subspecies	Length of spina sterni	S.D.	Length of coracoid	S.D.
C. v. virginianus Michigan	4.56 ±.05 (4.1–5.0) *n* 18	.23	29.59 ±.20 (28.5–30.9) *n* 19	.86
C. v. virginianus Illinois	4.46 ±.04 (3.9–5.0) *n* 37	.24	29.06 ±.15 (27.2–30.8) *n* 37	.91
C. virginianus subsp. North Florida	4.33 ±.07 (3.6–4.8) *n* 19	.29	28.31 ±.20 (27.3–30.1) *n* 19	.87
C. v. floridanus South Florida	4.04 ±.10 (3.6–4.6) *n* 10	.30	26.65 ±.32 (25.7–28.5) *n* 10	1.01
C. v. coyolcos Oaxaca, Mexico	4.40 (4.1–4.8) *n* 5	---	---	---
C. v. insignis Chiapas, Mexico	4.50 *n* 1		27.94 (26.9–28.9) *n* 5	---

Subspecies	Distal width of coracoid	S.D.	Proximal width of scapula	S.D.
C. v. virginianus Michigan	8.97 ±.11 (8.3–9.9) *n* 17	.44	6.98 ±.05 (6.5–7.4) *n* 19	.24
C. v. virginianus Illinois	8.87 ±.14 (8.0–9.6) *n* 39	.14	6.93 ±.04 (6.4–7.4) *n* 39	.24
C. virginianus subsp. North Florida	8.26 ±.02 (7.8–8.9) *n* 19	.11	6.45 ±.11 (5.7–7.0) *n* 20	.11
C. v. floridanus South Florida	7.82 ±.10 (7.2–8.2) *n* 10	.31	6.13 ±.09 (5.7–6.5) *n* 10	.28
C. v. virginianus Chiapas, Mexico	7.66 (6.9–8.4) *n* 5	---	6.38 (5.8–6.8) *n* 5	---

TABLE 8 (continued)

Subspecies	Length of humerus				S.D.	Proximal width of humerus				S.D.
C. v. virginianus Michigan	36.29	±.19	(34.8–37.7)	*n* 20	.86	9.62	±.02	(8.8–10.2)	*n* 20	.10
C. v. virginianus Illinois	35.34	±.18	(33.7–37.5)	*n* 26	.97	9.43	±.04	(9.0–10.0)	*n* 37	.26
C. virginianus subsp. North Florida	34.43	±.17	(32.8–35.8)	*n* 18	.72	9.12	±.07	(8.7–9.6)	*n* 19	.32
C. v. floridanus South Florida	33.29	±.38	(32.0–35.4)	*n* 10	1.19	8.79	±.12	(8.2–9.5)	*n* 10	.37
C. v. coyolcos Oaxaca, Mexico	33.78		(33.2–34.0)	*n* 5	---	8.90			*n* 1	---
C. v. insignis Chiapas, Mexico	33.80			*n* 1	---	9.04		(8.7–9.4)	*n* 5	---

Subspecies	Width of humerus below epicondyles				S.D.	Length of ulna				S.D.
C. v. virginianus Michigan	6.53	±.04	(6.3–6.9)	*n* 20	.18	32.45	±.13	(31.5–34.0)	*n* 20	.56
C. v. virginianus Illinois	6.36	±.04	(6.0–6.8)	*n* 30	.20	31.53	±.38	(29.3–32.7)	*n* 7	1.02
C. virginianus subsp. North Florida	6.17	±.05	(5.8–6.5)	*n* 18	.20	30.64	±.17	(29.5–31.9)	*n* 17	.68
C. v. floridanus South Florida	5.86	±.07	(5.5–6.2)	*n* 10	.21	29.54	±.25	(28.4–31.5)	*n* 10	.78
C. v. coyolcos Oaxaca, Mexico	6.00			*n* 1	---					
C. v. insignis Chiapas, Mexico	6.02		(5.9–6.1)	*n* 5	---	29.20		(28.6–29.8)	*n* 2	---

TABLE 8 (continued)

Subspecies	Proximal width of ulna	S.D.	Length of carpometacarpus	S.D.
C. v. virginianus Michigan	6.10 ±.04 (5.8-6.4) *n* 20	.16	19.36 ±.17 (18.5-21.2) *n* 20	.74
C. v. virginianus Illinois	5.84 ±.06 (5.4-6.0) *n* 9	.18	19.09 ±.17 (18.5-19.8) *n* 7	.46
C. virginianus subsp. North Florida	5.50 ±.05 (5.0-5.8) *n* 17	.20	18.23 ±.12 (17.2-19.3) *n* 18	.49
C. v. floridanus South Florida	5.31 ±.08 (5.0-5.8) *n* 10	.25	17.60 ±.19 (17.0-19.1) *n* 10	.60
C. v. insignis Chiapas, Mexico	5.35 (5.3-5.4) *n* 2	---	17.50 (17.5-17.5) *n* 2	---

Subspecies	Proximal height of carpometacarpus		Length from first to fourth synsacral vertebra	S.D.
C. v. virginianus Michigan	5.63 ±.05 (5.3-6.2) *n* 18	.20	12.89 ±.19 (11.7-13.8) *n* 16	.47
C. v. virginianus Illinois	5.51 ±.07 (5.3-5.9) *n* 7	.17	12.29 ±.07 (11.1-13.2) *n* 40	.47
C. virginianus subsp. North Florida	5.25 ±.05 (5.0-5.5) *n* 18	.19	12.15 ±.19 (10.6-13.4) *n* 17	.76
C. v. floridanus South Florida	5.09 ±.05 (4.7-5.4) *n* 10	.15	11.84 ±.18 (11.0-12.8) *n* 9	.55
C. v. coyolcos Oaxaca, Mexico	---	---	12.20 *n* 1	---
C. v. insignis Chiapas, Mexico	5.00 (4.9-5.1) *n* 2	---	12.02 (11.0-12.6) *n* 5	---

TABLE 8 (continued)

Subspecies	Length of femur	S.D.	Distal width of femur	S.D.
C. v. virginianus Michigan	42.56 ±.27 (40.5-45.8) *n* 19	1.19	6.94 ±.06 (6.6-7.6) *n* 19	.24
C. v. virginianus Illinois	41.29 ±.18 (38.8-44.8) *n* 37	1.07	6.77 ±.03 (6.4-7.2) *n* 39	.16
C. virginianus subsp. North Florida	40.12 ±.14 (38.6-42.0) *n* 19	.62	6.52 ±.05 (6.2-6.9) *n* 19	.21
C. v. floridanus South Florida	38.66 ±.40 (37.7-41.2) *n* 9	1.21	6.27 ±.10 (5.9-6.9) *n* 10	.30
C. v. coyolcos Oaxaca, Mexico	40.70 *n* 1	---	6.80 *n* 1	---
C. v. insignis Chiapas, Mexico	40.38 *n* 5	---	6.64 (6.6-6.7) *n* 5	---

Subspecies	Length of tibiotarsus	S.D.	Proximal width of tibiotarsus	S.D.
C. v. virginianus Michigan	57.17 ±.40 (54.8-60.9) *n* 19	1.73	9.06 ±.08 (8.4-9.7) *n* 19	.34
C. v. virginianus Illinois	55.75 ±.26 (53.2-58.0) *n* 31	1.44	8.89 ±.03 (8.4-9.2) *n* 40	.20
C. virginianus subsp. North Florida	53.86 ±.40 (51.3-57.0) *n* 18	1.70	8.52 ±.07 (8.0-9.1) *n* 18	.28
C. v. floridanus South Florida	52.09 ±.48 (49.7-55.1) *n* 10	.52	8.33 ±.10 (8.0-8.8) *n* 10	.32
C. v. insignis Chiapas, Mexico	51.95 (51.0-52.9) *n* 2	---	8.30 (8.0-8.6) *n* 2	---

TABLE 8 (continued)

Subspecies	Distal width of tibiotarsus	S.D.	Length of tarsometatarsus	S.D.
C. v. virginianus Michigan	5.41 ±.05 (5.1–5.9) *n* 19	.23	33.28 ±.26 (31.4–35.5) *n* 20	1.14
C. v. virginianus Illinois	5.22 ±.03 (4.9–5.5) *n* 40	.16	32.46 ±.18 (30.0–34.5) *n* 32	.99
C. virginianus subsp. North Florida	4.99 ±.04 (4.6–5.4) *n* 18	.18	31.03 ±.26 (29.4–34.0) *n* 18	1.17
C. v. floridanus South Florida	4.86 ±.08 (4.4–5.2) *n* 10	.25	30.65 ±.29 (28.9–31.8) *n* 10	.91
C. v. insignis Chiapas, Mexico	4.95 (4.8–5.1) *n* 2	---	29.15 (28.4–29.9) *n* 2	---

Subspecies	Proximal width of tarsometatarsus	S.D.	Distal width of tarsometatarsus	S.D.
C. v. virginianus Michigan	5.86 ±.05 (5.4–6.3) *n* 20	.22	5.71 ±.06 (5.3–6.3) *n* 19	.25
C. v. virginianus Illinois	5.67 ±.04 (5.0–6.0) *n* 37	.21	5.60 ±.04 (5.2–6.0) *n* 36	.21
C. virginianus subsp. North Florida	5.42 ±.05 (5.0–5.7) *n* 18	.20	5.31 ±.06 (5.0–5.8) *n* 18	.24
C. v. floridanus South Florida	5.31 ±.06 (5.0–5.6) *n* 10	.18	5.31 ±.04 (5.0–5.6) *n* 10	.14
C. v. insignis Chiapas, Mexico	5.35 (5.2–5.5) *n* 2	---	5.45 (5.4–5.5) *n* 2	---

TABLE 9.--SIZE VARIATION (MM.) IN FOSSIL *COLINUS*

Species	Distal width of coracoid			S.D.	Length of coracoid			S.D.
C. hibbardi Meade County	11.30		*n* 1	---	---			---
C. suilium Arredondo I	9.00		*n* 1	---	30.80	(30.3-31.3)	*n* 2	---
C. suilium Arredondo II	8.70		*n* 1	---	29.80		*n* 1	---
C. suilium Orange Lake	9.00	(9.0-9.0)	*n* 2	---	29.53	(29.2-29.9)	*n* 3	---
C. suilium Reddick A	9.05	(8.8-9.3)	*n* 2	---	28.83	(28.5-29.0)	*n* 3	---
C. suilium Reddick B	9.35	(9.3-9.4)	*n* 2	---	29.80		*n* 1	---
C. suilium Reddick C	---			---	29.65	(28.8-30.5)	*n* 2	---
C. suilium Reddick unspecified	8.79 ±.14	(8.3-9.4)	*n* 7	.39	28.99 ±.18	(27.8-30.1)	*n* 16	.72
C. virginianus Warren's Cave	8.20		*n* 1	---	27.70		*n* 1	---

Species	Length of tibiotarsus				Length from first to fourth synsacral vertebra			S.D.
C. suilium Arredondo I	60.00		*n* 1	---	13.00		*n* 1	---
C. suilium Williston	56.00		*n* 1	---	---			---
C. suilium Orange Lake	58.50	(58.2-58.9)	*n* 3	---	12.85	(12.3-13.4)	*n* 2	---
C. suilium Reddick A	57.20		*n* 1	---	---		---	---
C. suilium Reddick unspecified	---		---	---	13.80	(12.9-13.5)	*n* 4	---

TABLE 9 (continued)

Species	Width below epicondyles			S.D.	Proximal width of humerus			S.D.
C. suilium Arredondo I	7.10	(7.1–7.1)	n 2	---	10.20		n 6	---
C. suilium Arredondo II	6.75	(6.7–6.8)	n 3	---	10.00		n 1	---
C. suilium Williston	7.23	(6.5–7.3)	n 4	---	9.83	(9.2–10.2)	n 4	---
C. suilium Orange Lake	6.95	(7.2–7.3)	n 3	---	9.85	(9.5–10.1)	n 4	---
C. suilium Reddick A	6.67 ±.06	(6.4–7.0)	n 7	.16	9.66	(9.4–10.2)	n 5	---
C. suilium Reddick B	6.60	(6.3–7.0)	n 3	---	9.40	(9.2–9.6)	n 3	---
C. suilium Reddick C	6.54 ±.07	(6.3–7.0)	n 11	.23	9.50	(9.2–9.8)	n 6	---
C. suilium Reddick unspecified	6.63 ±.02	(6.3–7.0)	n 84	.16	9.75 ±.03	(9.0–10.2)	n 66	.28
cf. C. suilium Oakhurst Quarry	7.00		n 1	---	10.20		n 1	---
cf. C. suilium Eichelberger Cave	6.60		n 1	---	9.40		n 1	---
cf. C. suilium Lake Monroe	6.70		n 1	---	---		---	---
C. virginianus Kanapaha	6.35	(6.3–6.4)	n 2	---	9.20	(9.2–9.2)	n 2	---
C. virginianus Saber-tooth Cave	6.30	(6.2–6.4)	n 2	---	---		---	---
C. virginianus Vero, stratum 2	6.10	(5.9–6.3)	n 2	---	---		---	---
C. virginianus Vero, stratum 3	6.10		n 1	---	---		---	---
C. virginianus Vero, unspecified	6.00		n 1	---	9.10		n 1	---
C. virginianus Friesenhahn Cave	6.20		n 1	---	9.50	(9.4–9.6)	n 2	---

TABLE 9 (continued)

Species	Length of humerus			S.D.	Length of tarsometatarsus			S.D.
C. suilium Arredondo I	37.75	(37.6–37.9)	n 1	---	34.60		n 1	---
C. suilium Williston	35.83	(34.3–36.9)	n 4	---	---		---	---
C. suilium Orange Lake	36.40		n 1	---	---		---	---
C. suilium Reddick A	36.40	(36.6–37.6)	n 3	---	---		---	---
C. suilium Reddick C	35.13	(34.7–35.9)	n 3	---	32.80		n 1	---
C. suilium Reddick unspecified	35.91 ±.11	(34.5–36.8)	n 31	.60	32.86	(32.4–34.6)	n 7	---
Cf. *C. suilium* Haile II	---		---	---	33.70		n 1	---
Cf. *C. suilium* Oakhurst Quarry	34.90		n 1	---	---		---	---
Cf. *C. suilium* Eichelberger Cave	35.30		n 1	---	33.90		n 1	---
C. virginianus Kanapaha	35.45	(35.1–35.8)	n 2	---	---		---	---
C. virginianus Vero unspecified	34.80		n 1	---	---		---	---
C. virginianus Friesenhahn Cave	35.60		n 1	---	---		---	---

TABLE 9 (continued)

Species	Length of ulna			S.D.	Proximal width of ulna			S.D.
C. hibbardi Meade County	38.02	(37.4–38.7)	*n* 2	---	---		---	---
C. suilium Arredondo I	33.05	(32.8–33.3)	*n* 2	---	6.30	(6.2–6.4)	*n* 2	---
C. suilium Arredondo II	33.00		*n* 1	---	5.90		*n* 1	---
C. suilium Williston	34.00		*n* 1	---	6.60		*n* 1	---
C. suilium Orange Lake	---		---	---	6.00		*n* 1	---
C. suilium Reddick A	32.00		*n* 1	---	---		---	---
C. suilium Reddick C	31.30	(30.9–31.7)	*n* 2	---	5.90	(5.8–6.0)	*n* 2	---
C. suilium Reddick unspecified	32.33 ±.24	(30.7–33.6)	*n* 11	.78	6.11 ±.04	(5.7–6.5)	*n* 23	.21
Cf. *C. suilium* Haile II	---		---	---	6.40		*n* 1	---
C. virginianus Vero stratum 3	29.80		*n* 1	---	---		---	---
C. virginianus Friesenhahn Cave	31.00		*n* 1	---	---		---	---

TABLE 9 (continued)

Species	Length of carpometacarpus			S.D.	Proximal height of carpometacarpus			S.D.
C. hibbardi Meade County	22.20	(22.0–22.4)	n 2	---	5.90	(5.7–6.2)	n 3	---
C. suilium Arredondo I	19.30		n 1	---	5.50		n 1	---
C. suilium Williston	20.00		n 1	---	5.90		n 1	---
C. suilium Orange Lake	19.60		n 1	---	5.90		n 1	---
C. suilium Reddick C	19.05 ±.19	(18.1–19.9)	n 10	.61	5.63 ±.09	(5.3–6.1)	n 10	.27
C. suilium Reddick unspecified	18.93 ±.12	(18.0–19.8)	n 16	.47	5.75 ±.04	(5.4–6.1)	n 26	.18
C. virginianus Kanapaha	18.50		n 1	---	5.80		n 1	---
C. virginianus Saber-tooth Cave	18.30	(18.0–18.9)	n 4	---	5.50	(5.4–5.6)	n 4	---

Species	Proximal width of scapula			S.D.	Length of spina sterni			S.D.
C. suilium Arredondo I	---		---	---	4.90		n 1	---
C. suilium Arredondo II	7.10		n 1	---	---		---	---
C. suilium Orange Lake	7.13	(6.6–7.6)	n 3	---	---		---	---
C. suilium Reddick A	---		---	---	5.30		n 1	---
C. suilium Reddick C	7.00		n 1	---	---		---	---
C. suilium Reddick unspecified	6.94	(6.7–7.3)	n 7	---	4.85	(4.8–4.9)	n 2	---
C. virginianus Warren's Cave	6.50		n 1	---	---		---	---

TABLE 9 (continued)

Species	Distal width of femur			S.D.	Length of femur			S.D.
C. suilium Arredondo II	6.90		*n* 1	---	42.50		*n* 1	---
C. suilium Williston	7.05	(6.9–7.2)	*n* 2	---	43.60		*n* 1	---
C. suilium Orange Lake[1]	7.07				42.00	(40.6–43.0)	*n* 4	---
C. suilium Orange Lake[2]	6.60				---		---	---
C. suilium Reddick A	7.10				---		---	---
C. suilium Reddick B	7.10				---		---	---
C. suilium Reddick unspecified	7.00 ±.04	(6.6–7.6)	*n* 30	.20	42.41	(39.8–44.5)	*n* 6	---
Cf. *C. suilium* Zuber	6.60		*n* 1	---	42.10		*n* 1	---
C. virginianus Kanapaha	6.50		*n* 1	---	---		---	---
C. virginianus Saber–tooth Cave	6.70	(6.5–6.9)	*n* 2	---	41.90		*n* 1	---

[1] Arredondo clay

[2] Arredondo–Wicomico contact

TABLE 9 (continued)

Species	Proximal width of tibiotarsus			S.D.	Distal width of tibiotarsus			S.D.
C. suilium Arredondo I	9.65	(9.5–9.8)	*n* 2	---	5.45	(5.2–5.7)	*n* 2	---
C. suilium Arredondo II	---		----	---	5.57	(5.5–5.7)	*n* 3	---
C. suilium Williston	8.90		*n* 1	---	5.50	(5.2–5.7)	*n* 3	---
C. suilium Orange Lake	9.93	(9.8–10.0)	*n* 3	---	5.65	(5.3–5.8)	*n* 4	---
C. suilium Reddick A	9.03	(8.6–9.5)	*n* 3	---	5.50	(5.2–5.9)	*n* 4	---
C. suilium Reddick B	---		---	---	5.60	(5.5–5.7)	*n* 2	---
C. suilium Reddick C	---		---	---	5.23	(5.0–5.5)	*n* 3	---
C. suilium Reddick unspecified	9.23 ±.08	(8.8–9.7)	*n* 12	.26	5.58 ±.03	(5.2–5.9)	*n* 36	.18
Cf. *C. suilium* Eichelberger Cave	9.50		*n* 1	---	---		---	---
C. virginianus Saber-tooth Cave	8.50	(8.4–8.6)	*n* 2	---	---		---	---
C. virginianus Vero stratum 2	8.20		*n* 1	---	---		---	---
C. virginianus Vero stratum 3	8.30		*n* 1	---	---		---	---
C. virginianus Friesenhahn Cave	9.40		*n* 1	---	5.80		*n* 1	---

TABLE 9 (continued)

Species	Proximal width of tarsometatarsus			S.D.	Distal width of tarsometatarsus			S.D.
C. hibbardi Meade County	---		---	---	6.80	(6.6–7.0)	*n* 3	---
C. suilium Arredondo I	6.20	(6.0–6.4)	*n* 2	---	6.50	(6.5–6.5)	*n* 2	---
C. suilium Arredondo II	6.00		*n* 1	---	---		---	---
C. suilium Orange Lake	6.15	(6.1–6.2)	*n* 2	---	6.00	(5.7–6.4)	*n* 3	---
C. suilium Reddick A	5.80		*n* 1	---	---		---	---
C. suilium Reddick B	6.00	(5.7–6.3)	*n* 2	---	6.00	(5.7–6.3)	*n* 2	---
C. suilium Reddick C	---		---	---	5.93	(5.8–6.1)	*n* 3	---
C. suilium Reddick unspecified	5.88 ±.05	(5.4–6.4)	*n* 24	.23	6.03 ±.04	(5.3–6.5)	*n* 27	.23
Cf. *C. suilium* Haile II	5.90		*n* 1	---	---		---	---
Cf. *C. suilium* Eichelberger Cave	5.90		*n* 1	---	5.90		*n* 1	---
C. virginianus Warren's Cave	5.40		*n* 1	---	5.40		*n* 1	---

TABLE 10.--RATIOS (PER CENT) OF FEMUR AND TARSOMETATARSUS OF FOSSIL *COLINUS*

Species	Distal width / Femur length			Trochanter ridge length / Femur length		
C. suilium Arredondo II	16.2		*n* 1	24.1		*n* 1
C. suilium Williston	16.3		*n* 1	---	---	---
C. suilium Orange Lake	16.7	(16.7-16.8)	*n* 3	23.1	(22.6-23.5)	*n* 2
C. suilium Reddick unspecified	16.8	(16.7-17.0)	*n* 3	24.6	(23.7-25.7)	*n* 4
C. virginianus Kanapaha	16.3		*n* 1	24.3		*n* 1
C. virginianus Saber-tooth Cave	15.5		*n* 1	21.2		*n* 1

Species	Distal width / Metatarsal length			Proximal metatarsal depth / Proximal metatarsal width		
C. suilium Arredondo I	18.8		*n* 1	96.8		*n* 1
C. suilium Orange Lake	---		---	100.0		*n* 1
C. suilium Reddick A	---		---	96.5		*n* 1
C. suilium Reddick C	---		---	96.7		*n* 1
C. suilium Reddick unspecified	18.2	(17.6-18.6)	*n* 6	96.0	(90.9-98.4)	*n* 11
Cf. *C. suilium* Eichelberger Cave	17.4		*n* 1	100.0		*n* 1

TABLE 11.—RATIOS (PER CENT) OF ULNA AND SYNSACRUM OF FOSSIL *COLINUS*

Species	Height middle of ulnar shaft / Height distal to external cotyla		Length, first through fourth vertebra / Width, through fourth vertebra	
C. suilium Arredondo I	67.45 (65.1–69.8)	*n* 2	60.00	*n* 1
C. suilium Arredondo II	67.50	*n* 1	---	---
C. suilium Williston	62.50	*n* 1	---	---
C. suilium Orange Lake	---	---	62.30	*n* 1
C. suilium Reddick A	70.00	*n* 1	---	---
C. suilium Reddick C	67.92 (65.0–69.2)	*n* 4	---	---
C. suilium Reddick unspecified	68.00 (65.0–70.7)	*n* 16	---	---
Cf. *C. suilium* Haile II	65.10	*n* 1	60.45 (60.3–60.6)	*n* 2
C. virginianus Friesenhahn Cave	70.00	*n* 1	---	---

TABLE 12.--RATIOS (PER CENT) OF
FEMUR AND TIBIOTARSUS OF FOSSIL *COLINUS*

Species	$\frac{\text{Distal femoral depth}}{\text{Distal femoral width}}$		$\frac{\text{Depth inner cnemial crest}}{\text{Length inner cnemial crest}}$	
C. suilium Arredondo I	89.90	*n* 1	63.40	*n* 1
C. suilium Williston	89.30 (88.6-90.0)	*n* 2	66.70	*n* 1
C. suilium Orange Lake	84.25 (83.3-85.7)	*n* 4	55.33 (50.0-60.0)	*n* 3
C. suilium Reddick B	88.75 (87.7-89.8)	*n* 2	---	---
C. suilium Reddick unspecified	86.13 (77.8-95.4)	*n* 21	55.00	*n* 1
C. virginianus Kanapaha,	90.80	*n* 1	---	---
C. virginianus Saber-tooth Cave	84.60	*n* 1	---	---

TABLE 13.--RATIOS (PER CENT) OF
TARSOMETATARSUS AND SYNSACRUM OF FOSSIL COLINUS

Species	Middle trochlea depth / Distal width		
C. suilium Arredondo I	54.3	(53.8-54.7)	*n* 2
C. suilium Orange Lake	55.1	(53.2-56.9)	*n* 2
C. suilium Reddick B	56.3	(54.0-58.6)	*n* 2
C. suilium Reddick C	53.7	(52.5-55.2)	*n* 3
C. suilium Reddick unspecified	56.3	(54.0-58.6)	*n* 2
Cf. *C. suilium* Eichelberger Cave	54.7	(51.7-59.0)	*n* 23

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BIOGRAPHICAL SKETCH

J. Alan Holman was born in Indianapolis, Indiana, on September 24, 1931. Undergraduate study at Franklin College of Indiana resulted in the degree of Bachelor of Arts with Distinction in Biology in June of 1953. After graduation he served on active duty in the United States Naval Reserve until 1955. Graduate study was begun in September of 1955 at the University of Florida, where the Master of Science degree was received in June of 1957. Graduate assistantships were held at the University of Florida. He is currently employed as Assistant Professor of Biology at Howard College, Birmingham, Alabama. He is a member of Blue Key, the Society of the Sigma Xi, Chi Beta Phi Scientific Society, Phi Sigma and Tri Beta Biological Societies, the American Ornithologists' Union, Herpetologists League, American Society of Ichthologists and Herpetologists, Society of Vertebrate Paleontology, Society for the Study of Evolution, and the Florida Academy of Science.

This dissertation was prepared under the direction of the chairman of the candidate's supervisory committee and has been approved by all members of that committee. It was submitted to the Dean of the College of Arts and Sciences and to the Graduate Council, and was approved as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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